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Vol. XLIII

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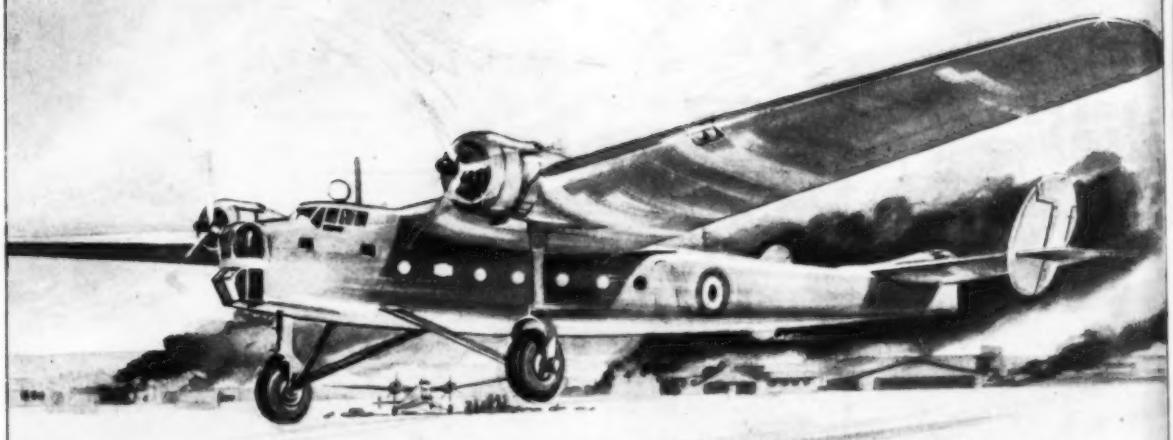

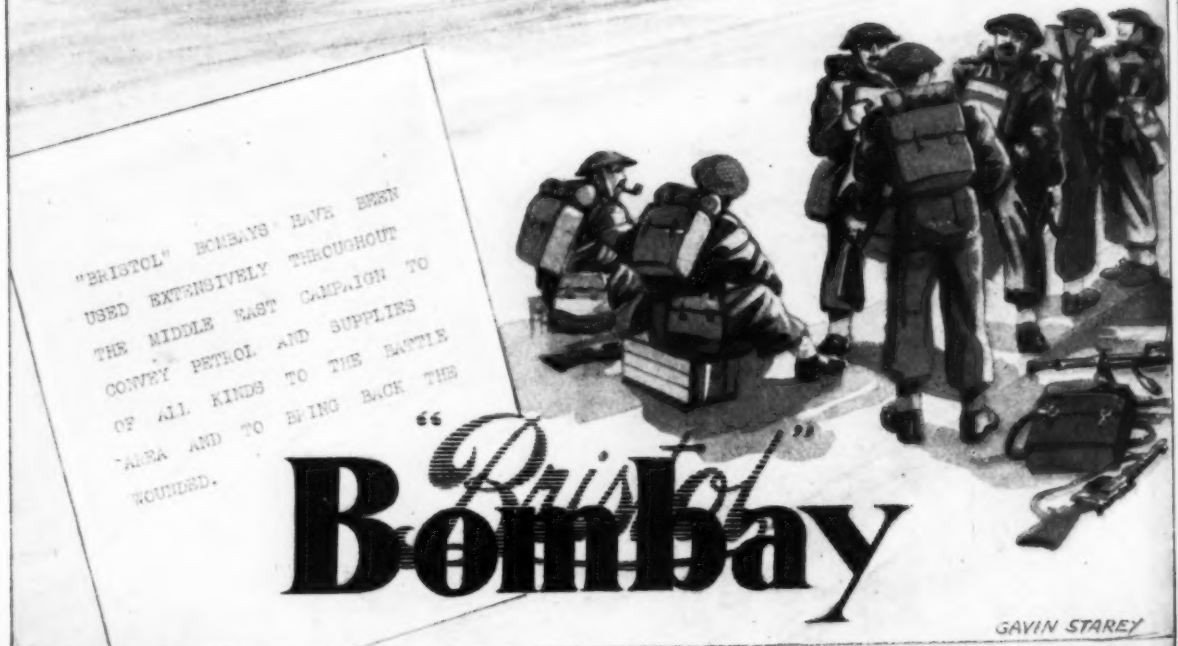
"BRISTOL" BOMBAYS HAVE BEEN
USED EXTENSIVELY THROUGHOUT
THE MIDDLE EAST CAMPAIGN TO
CONVEY PETROL AND SUPPLIES
OF ALL KINDS TO THE BATTLE
AREA AND TO BRING BACK THE
WOUNDED.

"Bristol" Bombay

GAVIN STAREY

THE BRISTOL AEROPLANE COMPANY LTD.

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The Outlook

An Air Odyssey

IT is a moot point whether the Prime Minister or Field Marshal Wavell has travelled the greater number of miles by air since this war began. H.E. the Commander-in-Chief in India had a good start, but by now Mr. Churchill must be catching him up, if he has not already passed him. Both fly for very serious purposes, but there is something distinctly romantic about the way in which Mr. Churchill descends from the skies in the most unexpected places at the most unexpected times.

His dramatic meeting with his old regiment, the 4th Hussars, in Cyprus recalls a story told by the late Lord Baden Powell in one of his books of Indian memories, which we may be excused for quoting here. After a polo match Lt. Churchill was getting a bit obstreperous in mess, so his Colonel told two other subalterns to take him away and sit on him. It was done, but Churchill shortly reappeared, somewhat crumpled, and said to the C.O., "It's no use, sir, you can't keep me down."

The meeting with the Turks at Adana recalls no frivolous incidents. One does remember, however, that for a long time past the Turks have shown great interest in British aircraft. They sent a mission, including a splendid pilot, over here in the days when Lord Swinton was Air Minister, and when Gauntlets were the latest thing. The pilot flew one in a most accomplished manner, praised it, but declared that they would wait until Lord Swinton could afford to let them buy some Gladiators, as they only wanted the best. Since then the Turks have acquired Hurricanes, but only (so far as has been published) of the Mark I variety; Blenheims, also Mark I; Battles, Lysanders, Southamptons and Walruses, in addition to Heinkel Ills and some American types. More modern equipment will be needed to face the *Luftwaffe* if Germany should invade Turkey.

With the German armies retreating with all speed from the Caucasus, and unlikely to escape, the danger to Turkey seems more remote than at any time in the last two years. But a martial people like the Turks naturally wish to feel that they can defend themselves if attacked, and one never knows to what follies Hitler may not be driven by the Furies which he calls "Intuitions." Britain and America can now afford to spare aircraft and weapons for their friends and allies, and the promises which Churchill made at Adana will greatly strengthen the bonds between Turkey and Britain.

Sackcloth and Ashes

WHEN one casts one's mind back to all the boasting by Hitler and other leaders of the Nazis and the Fascists, the order that Germans shall mourn three days for their Sixth Army, lost at Stalingrad through Hitler's folly, fills one with amazement. Hitler has always been a puzzling psychological study, but this order of his is the most amazing of all his performances. Not in that spirit did the British peoples face the loss of Hong Kong and Singapore, and all the other trials which have afflicted them since September, 1939. At such a time as this one would have expected a great leader to call upon his people to set a stiff upper lip, and to have said and done everything possible to cheer them. The donning of sackcloth is no way to encourage drooping spirits in the hour of catastrophe.

Perhaps a few Germans may feel a distorted satisfaction at the order for the mourning, namely, those Generals who warned Hitler (for some of those highly trained professional soldiers must have warned him) to be cautious about the assault on Stalingrad, and who got dismissed for their pains. "Intuitions" will not for ever compensate for lack of professional training.

If the order to mourn means that Hitler has at last begun to distrust himself, the end of the war may be nearer than some of us have dared to hope. It is now too late for even the German General Staff to stem the tide of defeat.

To metaphorical sackcloth have been added very material ashes. Berlin has been bombed three times lately, by night and by day, but the damage done is not yet known to us. Then came the turn of Cologne. That city was the victim of the first 1,000-bomber raid by the R.A.F., and in that raid some 250 factories were destroyed or badly damaged. The Germans set to work to make repairs, and it is now known that they sorted and removed 450,000 tons of rubble from the ruins. That was six times the amount taken away from Coventry. The removal of this rubble put a considerable strain on the Rhine traffic.

The R.A.F. waited until some progress had been made with the repairs, and then on February 3rd they started again. In one brief but terrible period of twenty minutes one hundred bombs of the 4,000 lb. calibre, and innumerable other bombs, were rained down upon the partially repaired city. The news cannot be prevented from spreading over the Reich, and it will add to the gloom already aroused by the sackcloth and the reason for wearing it. And that dire night was not the end.

The Cart and the Horse

FOLLOWING up various articles and comments on post-war civil aviation which we have published in previous issues of this journal, we give this week a summary of the result of informal discussions which we have had with leading men in a famous aircraft firm. The discussions focused light on a fact which we had stressed on several occasions: that before much progress can be made it is essential that the Government should give a lead.

No one would expect the Government to table detailed plans. To do so would obviously be impossible at present. But if Mr. Churchill and Mr. Roosevelt were able to give the world the Atlantic Charter, surely the Government could give us a charter, on equally broad and general lines, setting forth what it is and is not prepared to do with British civil aviation after the war.

The recent appointment of the Brabazon inter-departmental technical committee by the Secretary of State for Air and the Minister of Aircraft Production places the cart before the horse. There is little purpose in having an inter-departmental committee "to inquire and advise in regard to the question of the development of types of aeroplanes for civil aviation and to report as soon as possible" until the Government has decided how and where these types are to be used.

More helpful is the plea put forward by the joint committee of the Chambers of Commerce, under the chairmanship of Mr. Oliver E. Simmonds, that a Parliamentary Standing Committee should be set up to cover the whole field of post-war civil aviation. That suggestion was originally made in this journal several months ago, and still appears to us the most promising beginning. The subject is far too great for any inter-departmental committee, the work of which does not rightly begin until the broad outlines have been settled. There need be little surprise that the Shelmerdine inter-departmental committee "has not met for a long time," as Sir William Jowitt said in the House the other day. We believe we are right in thinking that that committee asked for guidance on certain very important points, and that such guidance was not forthcoming from the Government. A standing committee of both Houses might succeed in obtaining the guidance where the inter-departmental committee failed.

The fundamental question is: Is the air to be "free," and are we to have more than one "chosen instrument"?

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DAWN ARRIVAL: An Avro Lancaster, back from a raid, taxies to its dispersal point. Judicious use of the wheel brakes, and power from the two inboard Merlins, make the Lancaster very easily handled on the ground.

UNTURRETED : Eighth Army transport Hudsons taking supplies up to the forward airfields.

WAR in the AIR

Good Work in January : Malta's Fine Record : Sicily Under the Hammer : Stukas in Tunisia

THE generally mild weather of January, despite some interruptions by gales and a good deal of low cloud, helped both the Russian armies and the R.A.F. in their attacks on German power. On every day and night in the month the R.A.F. was out on operations of one sort or another, frequently on several at the same time. Bomber Command had machines in the air on 22 nights and 29 days. Sometimes they were striking directly at the enemy's war effort, sometimes laying mines, and sometimes helping Coastal Command in anti-submarine patrols. By night 16 bombing attacks were made on Germany and six on occupied territory. Lorient received five visits and Bordeaux one. The U.S. Army 8th Air Force also bombed Lorient once in daylight. At that place ten acres have been devastated in the Naval Arsenal alone, and there has been much other damage, which must certainly reduce the volume of German U-boat activity.

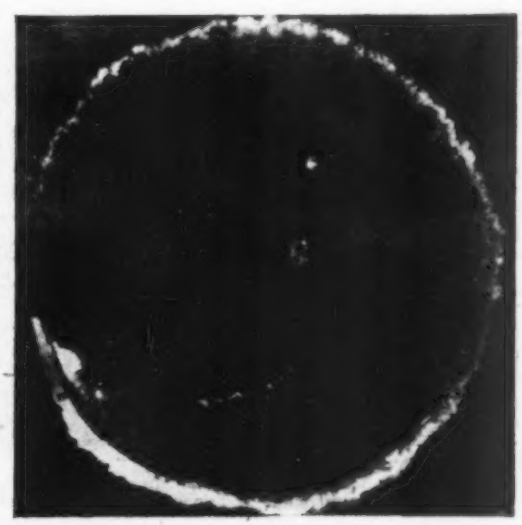
Coastal Command flew continuously during the month, and some of its machines joined with those of Bomber Command in the night raid on Bordeaux on the 26th. St. Nazaire was raided by the Americans on the 3rd, and the U-boat pens were hit, though with what effect has not been made known. Occasionally reports of the results of mine-laying are received, and it is known that Kiel Bay was closed to all traffic for two days.

Shipping protection took up some 85 per cent. of the efforts of Coastal Command, and 20 per cent. of those of Fighter Command.

Another interesting record has been published at Malta. The A.O.C., Air Vice-Marshal Sir R. K. Park, has stated that in the year 1942 the fighter squadrons and A.A. guns of the island shot down 915 enemy aircraft (and 261 more were probably destroyed) for the loss of only 106 pilots and 195 machines, although the R.A.F. defensive strength there never exceeded half a dozen fighter squadrons.

Two outstanding events of the last week were the Prime Minister's flying tour on from Casablanca to Adana in Turkey and to Cyprus, and the great raiding of Cologne, both of which are discussed in our leading columns of this issue. Other big raids followed that on Cologne.

Things have been stirring in the South-West Pacific, and before this article is closed for press we may receive some definite reports of the sea and air battle which has been raging there for some time between the



MOVING IN GOOD CIRCLES: A Japanese aircraft carrier making life difficult for Fortress bomb aimers.

WAR IN THE AIR

Americans and the Japanese. The Japanese, as usual, got in first with a claim to tremendous successes, stating that they had sunk five U.S. warships, including two or three battleships, and damaged three others. The Navy Department in Washington said that these claims were grossly exaggerated. Japanese claims usually are.

It is interesting to note that in New Guinea, where the Australians are fighting in the area of Mabo and Wau, they have been much helped by field guns brought over in American transport aircraft. The Japanese in those parts are said to have no artillery, which must mean that they have no chance of getting the best of things.

Mr. Churchill's Prophecy

WHILE the Prime Minister was in Cyprus, he remarked that the British Government had poured half a million men and more into North Africa, and added: "Soon they will be turning north across the sea." Of course that remark only repeats the statements of other Ministers that North Africa was to be a springboard (that word has become very popular with Ministers of late and has been rather overworked), but we may be sure that the German High Command recalls another remark made by Mr. Churchill not long ago, when he said that he considered it quite legitimate to deceive the enemy, and the enemy must be guessing now whether all this talk about an invasion of the Continent from the "under-belly" side may not conceal an intention to invade Norway.

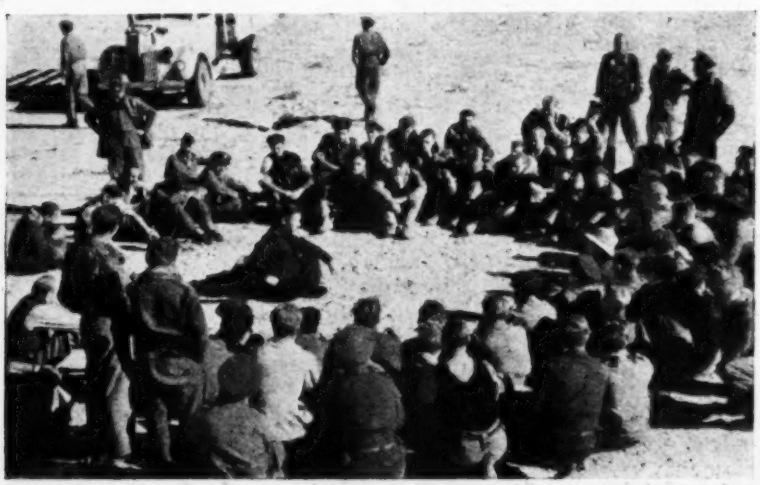
Certainly to a lay onlooker the prospects of an attack from the south look very promising, for the Axis cannot yet have fortified the coasts of France, Italy, Greece and the islands to anything like the same extent as the shores of the Channel and the North Sea. Desperate measures are being taken in Marseilles, where the Old Town is to be pulled down and reconstructed as a German fortress or U-boat base. It must be largely with the idea of fending off, or at least postponing, an Anglo-American attack from the south that the Germans are making such tremendous efforts to delay the Allies in Tunisia and to secure the junction of Rommel's remaining forces with those of Arnim already there. They have succeeded in getting across some of their new and heaviest tanks, a few of which have succumbed to the fire of British guns. They have also used a number of dive-bombers to hold back the Allies from reaching the sea, and the Stukas seem to have been skilfully handled and to have met with some success, although when Spitfires get at them the Germans always suffer losses.

STERN ATTACK: Fighting off an attack by a Mitsubishi Navy G-97-1 torpedo-bomber on an American carrier. Shortly after this picture was taken a bomb scored a direct hit on the flight deck.

Attack and Defence

THE Allies, while using aircraft and submarines to reduce the flow of men and material into Tunisia, are also using their bomber force to hammer Sicily and other enemy bases. Malta is no longer the gallant victim of bombers based in Sicily, but is hitting at Sicilian ports and airfields, notably Palermo and Messina, with terrific vim. American bombers from the East and from the West are taking an enthusiastic share in this onslaught. Sicily is now the victim in its turn, though the peasants in the island have no fear of the Allied bombers, knowing that they only strike at military objectives. Some of the raids, for example that on the train ferry between Messina and Reggio, are of a defensive nature, intended to cut the supplies for Tunisia, but, when the whole bombing campaign is considered in connection with the rapid advance of the Eighth Army on the heels of Rommel, it bears the appearance of a grand preparation for an offensive. The Germans, as was said above, must be wondering whether this appearance is real or deceptive.

There have been no particular signs that the *Luftwaffe* has been massed on the Mediterranean front, but there



FAREWELL TALK: Air Chief Marshal Sir Arthur Tedder lecturing to an informal gathering of pilots in Tripolitania before he returned to England to take up his appointment as Vice-Chief of the Air Staff.

WAR IN THE AIR

ENEMY AIR LOSSES TO FEB. 6th.

	Over G.B.	Over Continent	Middle East
Jan. 31	0	0	0
Feb. 1	0	0	2
" 2	0	2	1
" 3	1	3	0
" 4	0	1	0
" 5	1	1	1
" 6	0	0	0
	2	7	4

Totals : West, 6,606 : Middle East, over 5,210.

have been for some time past indications that there have been substantial withdrawals of its squadrons from Russia. . The Germans and their satellites there have already lost immense quantities of booty to the advancing Russians, and it looks as if they will shortly lose much more. Perhaps they have decided to send away a good proportion of their squadrons while the going was still good. Much of the ground equipment would necessarily have to be left behind, but it may have been thought well worth while to get as many of the machines and crews away, even though by doing so they left their ground troops without enough air support. One Russian report of booty captured recently on one sector mentioned 143 tanks, 516 guns, 32 military trains, many smaller weapons, but no aircraft at all. On other occasions the Russian reports have mentioned numbers of enemy aircraft captured and destroyed which seemed quite insignificant compared with the huge hauls of tanks and guns.

BRITISH & U.S. AIR LOSSES TO FEB. 6th.

	Over G.B. A'crft.	Over Continent B'brs.	Over Continent F'trs.	Middle East A'crft.
Jan. 31	0	0	0	0
Feb. 1	0	0	0	0
" 2	0	7	8	0
" 3	0	16	0	1
" 4	0	3	0	0
" 5	0	0	1	1
" 6	0	3	3	1
	0	29	12	3

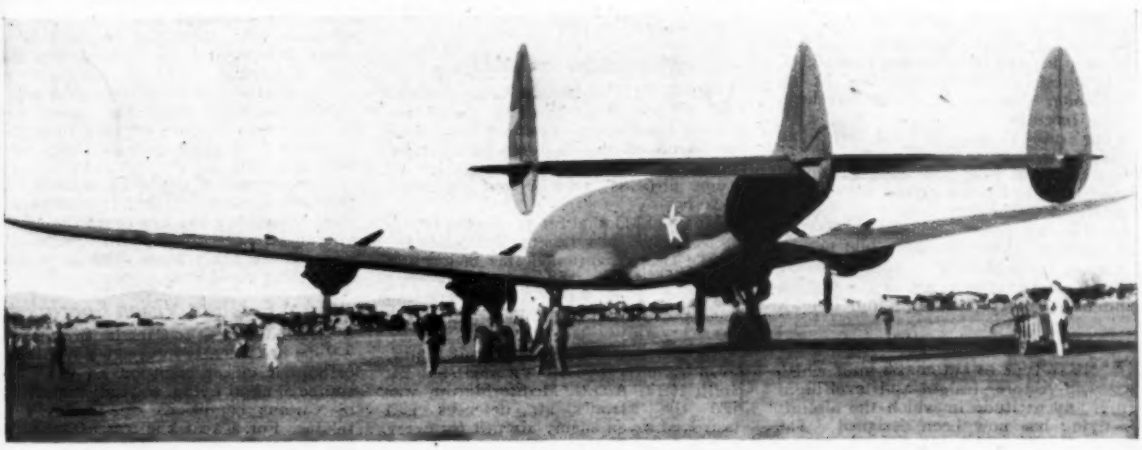
Totals : West, 5,165 ; Middle East, about 2,067.

EEL'S EYE VIEW : A Latécoère 298 torpedo seaplane, which was being used by Vichy in the Gulf of Arzeu before the Allied occupation of North Africa. The torpedo is carried in a special bay under the fuselage. The Latécoère 298 is powered by an 880 h.p. 12-cyl. "V" type liquid-cooled Hispano-Suiza 12Ycrs engine with Ratier airscrew, and has a top speed of 186 m.p.h. at 6,500 feet. Its span is 50ft. 10in.

East and West

THE airfield in New Guinea at which the field guns have been landed is at a place called Wau, to the south-west of Salamaua, and the Japanese have made serious attempts to interfere with it. Last Saturday there were desperate air battles above it. The American transports had to turn back when a strong Japanese force was found to be bombing the landing ground ; but the escort of eight Kittyhawks attacked the enemy at 2,000 feet and Australian A.A. gunners on the ground joined in. At the same time Airacobras higher up engaged other Japanese machines at 12,000 feet. In each case the American fighters scored complete victories without losing a single machine themselves. The enemy losses were very heavy.

It has been made known that there is a squadron of Mosquitoes at Malta now, which for some weeks past has been striking out in all directions, at Sicily, at Italy, and at Tunisia, by night as well as by day. Other types have also played their part, and now railway travel in southern Italy is by no means the safe and easy matter that it recently was. Goods trains have been riddled with fire from end to end, but when the British pilots see a passenger train they only attack the engine. Bomber Command has kept up its periodical raids on northern Italy.



TRIPLE TAIL TRANSPORT : An unconventional view of the Lockheed Constellation (four 2,000 h.p. 18-cyl. Wright double-row Cyclones) in which the men walking towards the machine provide an indication of its size.

HERE AND THERE

Combined Air Offensive

BRIG. GEN. N. LONGFELLOW, Commanding General of the Eighth Bomber Command of the U.S. Army Air Force, has received a message of congratulation on the first U.S. raid on Germany from Air Marshal Sir Arthur Harris, Commander-in-Chief of Bomber Command, in which it is stated that "between us we can and will bust Germany wide open."

Long, Long Trail

A REMINDER of the unceasing flow of "the tools" from the American Continent to the various theatres of war reached us in a recent letter from Canada.

"A steady stream of American aircraft passes through here all the time," said our correspondent, "and a large proportion bears the red star of Russia. Bostons, Mitchells, Fortresses, Liberators, Kittyhawks, Airacobras, and Lightnings are well represented among the types seen."

Low Percentage Loss

FIGURES dealing with the losses of our home-based bombers in raids over Germany and enemy-occupied territory in Europe, disclosed last week in Parliament, show that the average is appreciably less than two machines per raid.

The total lost since the start of the war was 2,579, and during that period the R.A.F. had made 596 raids on Germany alone, excluding a number of small daylight attacks.

Fuel Possibilities

EXISTING aircraft engines cannot fully utilise the very much higher octane value of petrol recently produced by a new process in America, it is announced.

Refineries are now being built in order that use may be made of the new method, and developments in the design of more powerful aircraft engines are envisaged.

Flying Boats of the Future

CIVILIAN flying boats of 200 tons, with a speed of between 300 and 400 m.p.h., and carrying 100 passengers, were foreshadowed by Sqn. Ldr. H. M. McKenna, director of Short Brothers, Ltd., recently.

The design staff of that firm had investigated the possibility of such flying boats and were now considering the construction of boats of 100 tons immediately after the war.

With a power plant of about 18,000 h.p., these aircraft would have a cruising speed of approximately 275 m.p.h., a range of about 3,000 miles, and would carry passengers and freight.

"George II"

A NEW type of automatic pilot which will restore straight and level flight from any attitude in which the aircraft is flying has now been designed. The device consists of a series of hydraulic servo-motors which can be switched on or off by means of a ring attached to the control column.

The new automatic pilot remains in the "off" position while the pilot is holding the "stick," but is turned on, bringing the aircraft into level flight from any attitude, when he removes his hands.

The old "George" kept the aircraft in whatever attitude it happened to be when "he" was switched on. Thus its use was limited to maintaining a path previously set by the human pilot.

A.T.C. Now Two Years Old

THE second anniversary of the formation of the A.T.C. has recently been celebrated, and the King sent a message of thanks for the expression of loyalty received from the Corps.

The A.T.C. now numbers 230,000, including officers, instructors, deferred service men and cadets, and it is estimated that about half the cadets in the Corps flew with the R.A.F. or the Royal Navy during the year.

Major Paul Youngs, U.S. Army Air Force, with his fiancée, Daphne Osborn-Jenkyn, W.A.A.F. (see para.).

Mosquitoes on Malta

A MOSQUITO squadron, with plenty of experience of intruder raids over France and Holland, is now stationed on the island of Malta; their present speciality is night intruder attacks on enemy airfields in Sicily and the south of Italy.

Air Chief Marshal Sir W. Sholto Douglas, who has just become A.O.C.-in-C., Middle East, mentioned this in his first press conference the other day and described it as "the most interesting development in the Middle East air war."

Another interesting fact about Malta, given recently by Air Vice-Marshal Sir Keith Park, A.O.C. Mediterranean, was that the island's air defences had destroyed seven enemy aircraft for every R.A.F. pilot lost in 1942.

"A handful of Hurricanes and Spitfires," he said, had shot down 733 enemy aircraft, not counting 300 probables, and the A.A. guns had accounted for another 182. We had lost 196 machines and 106 pilots.

Post-war Air Lines

MR. HENRY WALLACE, Vice-President of the United States, has put forward a scheme for post-war world airlines, utilising the great airports that have been built for war purposes and the personnel of the International Air Force which, it is suggested, should be formed to ensure peace in the post-war world.

His idea is that instead of a large military air force merely standing by ready for action, which would be a big expense, the men could also serve as air and ground crews of the United Nations' air network, which in peacetime would carry passengers and freight.

Such a combined force as Mr. Wallace proposes would be less costly, he suggests, and more effective.

Anglo-American Alliance

MANY of our readers in and out of the Services will have met Paul Youngs (now Major in the U.S. Army Air Force) as for a considerable period he acted as resident engineer to the Curtiss-Wright Corporation, on engine matters, visiting the various maintenance depots in this country.

Soon after America entered the war, Youngs returned to the States to join up and is now back again as a major in the U.S. Army Air Force with the appointment of Chief Technical Inspector at the Headquarters of the 8th Air Force Service Command.

An interesting item of news is that he is engaged to be married on February 27th to Daphne Osborn - Jenkyn, W.A.A.F.

"Parsimony" and Perspective

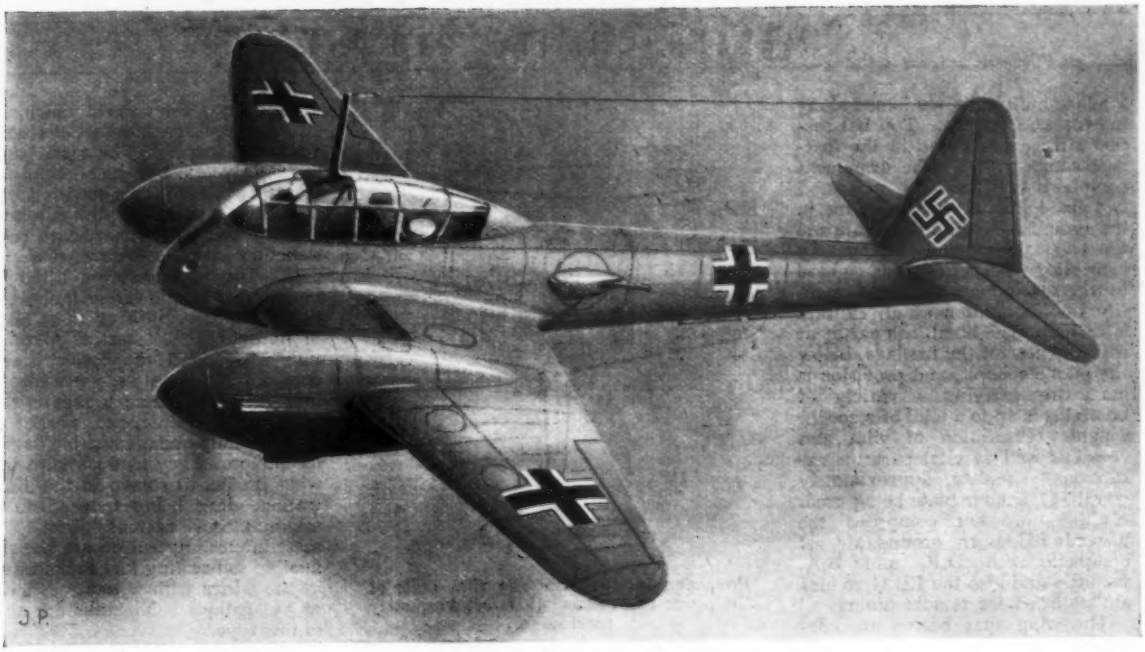
ALTHOUGH Britain and America sent, among other supplies, 4,600 aircraft to Russia up to December 1st last (which, as Lord Portal pointed out, exceeded the agreed requirements of the Russian Government), Lord Beaverbrook recently referred to the flow as "parsimonious" and said that the Russians had captured more tanks and aircraft from the Germans since the present offensive than they had received from Great Britain and the U.S. during the past 20 months.

The obvious inference from that argument would be that the more war material the Russians capture from the Germans, the more material help they need from us!

In any case, it might be pointed out that the number of aircraft sent represents something like five times the whole aircraft strength of the R.A.F. before the war—so we can't have done so badly, everything considered.

W.A.A.F. Night Vision Specialist

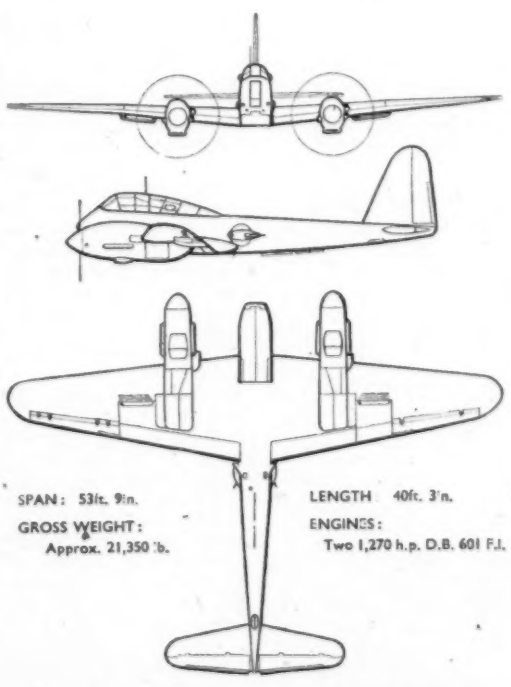
DURING a visit to Canada, from which she has recently returned, a W.A.A.F. orthoptist officer went on an extensive course of night flying, to study the effects of various conditions on the eyes of pilots. For a year she was attached to the R.C.A.F. and crossed Canada with thirteen other Canadian women orthoptists, setting up a chain of night-vision testing clinics.



An artist's impression of the Messerschmitt 210 A-1.

Messerschmitt 210 A-1

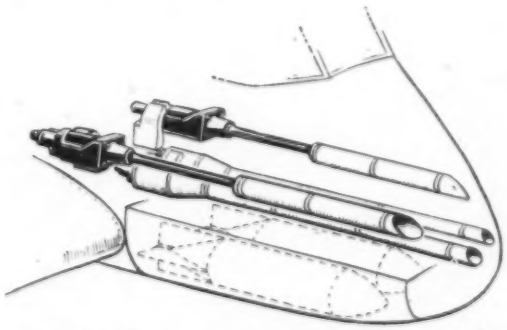
Germany's Long-range Fighter Bomber : Remotely Controlled Guns



General arrangement of the Messerschmitt 210 A-1

ANOTHER type of fighter bomber captured by Britain is the Messerschmitt 210 A-1, a low-wing monoplane carrying a crew of two, comprising the pilot/bomb-aimer and radio operator/rear gunner. It can be used as a long-range fighter, dive bomber or for ground attacks, and is a development of the now familiar Me 110. In the aircraft recently examined by *Flight* two D.B.601 F.1 engines were fitted. These appear to differ from the 601E found in the Me 109F only in having a special cooling duct fitted on each side for directing cool air over exhaust stubs and into the sparking plug wells, which system is described later. The coolant radiators are of the ducted type as used in the Me 109F.

The recent tendency to build the wing as a single unit passing through the fuselage is followed, and except for this the structural design is in line with previous Messerschmitt construction, that is, a single-spar wing and a

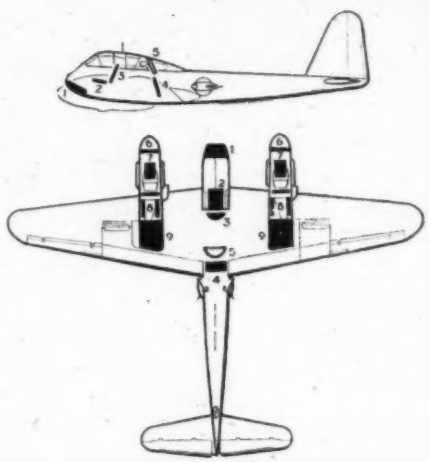


The two fixed 7.9mm. and two Mauser 20mm guns in the nose showing the "blast" tubes and the bomb stowage below

D

MESSERSCHMITT 210 A-1

fuselage built in halves joined along the top and bottom. Top hat section stringers are used in the fuselage construction. The armament comprises two fixed 7.9 mm. and two fixed Mauser 20 mm. guns in the nose. A notable departure are the two 13 mm. guns in remotely controlled "barbettes" and sighted by the rear gunner. A large quantity of ammunition of all calibres is carried. The bomb compartment is in the nose of the fuselage, below the pilot's cockpit, and provision is made for carrying a variety of bomb loads up to a total of 2,200 lb. weight. Protection of pilot and crew, as well as vital parts, is exceptionally replete, approximately 900 lb. of armour plate being used. Radio equipment comprises the normal FU.G 10 ground/air set complete with D.F. and B.A. facilities and also the FU.G 16 air/air set fitted for remote tuning.

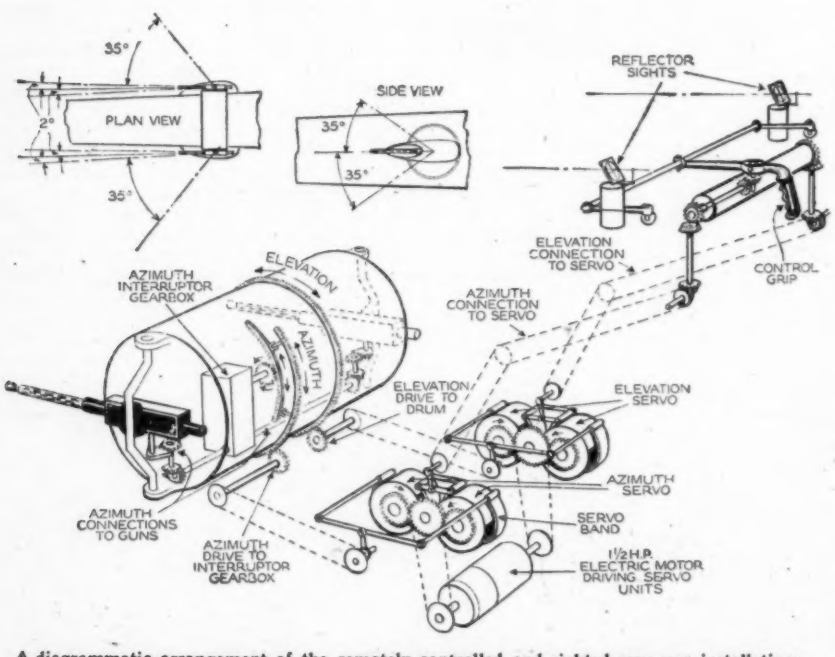


Protection for the crew and vital parts of the power plant installations are adequately provided for.

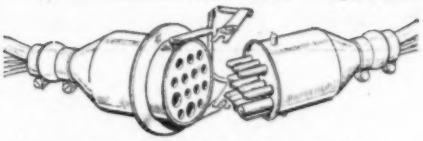
The wing spar booms are constructed from "L" section aluminium alloy extrusions placed back to back to form a "T" section with the web between. The booms are further strengthened by a flat plate extrusion at the top of the "T" section and the whole riveted together. Top hat section stiffeners are riveted to the web at frequent intervals. At the joint of the outer wing and centre section the spar plates are fitted with self-aligning bushes, and a central shear attachment between top and bottom joints is likewise bushed. A further attachment of the outer wing to the centre section is made at the leading edge by an extremely large ball joint, the wing at this point being reinforced by a special additional rib and thick gauge skin. The end ribs are pressings, the webs of which are strengthened by corrugations conveniently spaced. The metal skin is flush riveted, but the ailerons are fabric covered. This method also applies to the tail unit, the tailplane and fin being of stressed-skin construction with fabric-covered elevators. Diving brakes are fitted to both upper and lower surfaces, the upper brake comprising three slats of extruded "L" section aluminium alloy, and the lower brake comprising four slats. An ingenious feature of these brakes is the method of retraction, which is hydraulically operated with a parallel motion. They fit flush with the wing profile, as shown in the illustration, drag being reduced to a minimum in normal flight. A most interesting feature are the six flexible self-sealing fuel tanks fitted in the wings with a total capacity of 550 gallons. Oil tanks are also of this type.

As already stated, the fuel and oil tanks are completely flexible and appear to approach the ideal of a crash-proof tank. The fibre sheet previously used on German tanks is completely dispensed with in this aircraft, the flexible skin taking the form of a self-sealing rubber compound of approximately ¼in. thickness, this being again reinforced at the outer and longitudinal seams by additional thicknesses. As a result the tank is heavy in comparison with normal construction. Fuel tanks are housed within the wing and centre section, and are slung from the upper skin from two main attachments. These take the form of a circular bracket on the tank, with four raised lugs, which are bolted to the metal skin of the wing. Five other metal discs of smaller diameter with a central bolt attachment from the tank to the wing covering assist in preventing the tank from sagging as fuel diminishes during flight. Apparently no provision is made for jettisoning the fuel. The flexible oil tank situated at the rear of the engine nacelle and behind the main spar has no rigid attachment to the structure. A cover plate is bolted over the tank when in position.

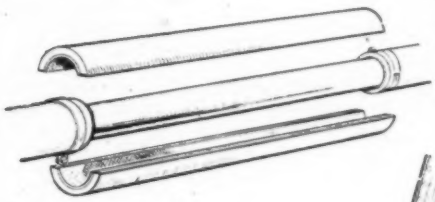
The engine mounting is particularly interesting, as the principle of design, as will be seen from the sketch, is a complete reversal of previous German practice. The main supporting members are welded steel box girders in compression and incorporating the standard type of shock absorber mounting held in position by large-diameter circlips at the two pick-up points on the engine. They extend to the fireproof bulkhead, where the attachment takes the form of a ball joint. A diagonal tubular member in tension runs from the top

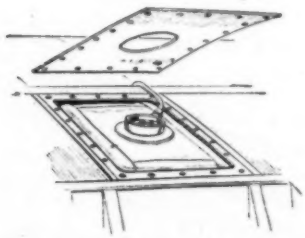


A diagrammatic arrangement of the remotely controlled and sighted rear gun installations. Actually the electric motor drives the servo-units via gears, and the complete unit is compactly mounted within the aircraft.

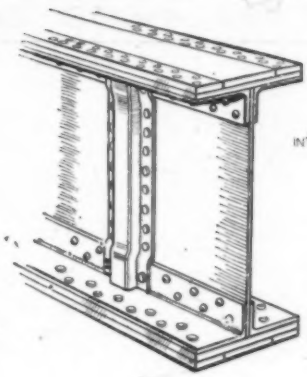


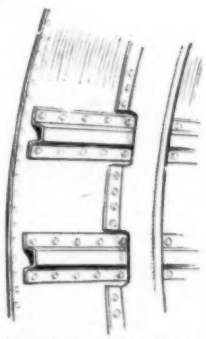
(Above) The electrical equipment multi-plug socket at the centre section joint.
(Below) "C" section armour plating felt-lined over the coolant pipes.



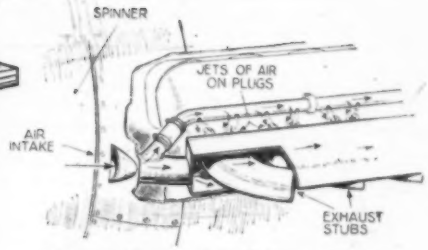


The flexible oil-tank housing at rear of engine nacelles.

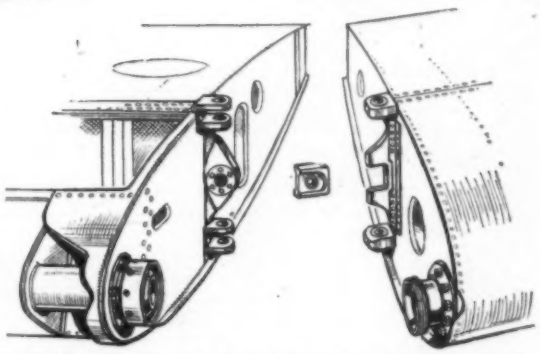




An example of the fuselage stressed-skin construction.



(Above) The special cooling duct fitted each side of the engine for directing cool air over exhaust stubs and into sparking plug wells.
(Left) A section through the main centre section spar.



Attachment of outer wing to centre section. Note the central shear attachment and the powerful ball joint at the leading edge.

joint on the bulkhead to pick up the main member at an angle of approximately 45 deg. The mounting is extremely simple and should facilitate production due to the minimum of structural members involved.

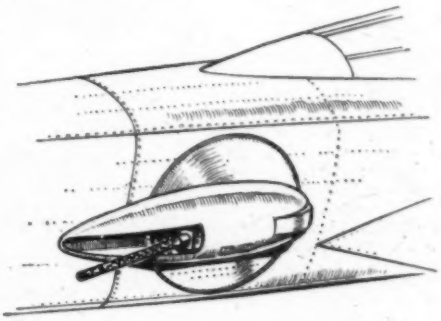
Remote Control of Guns

Probably the most ingenious feature of the whole machine technically is the installation of two 13 mm. guns in "barbettes," both sighted and remotely controlled by the rear gunner. A schematic illustration of the arrangement explains the layout. Both guns can be elevated approximately 35 deg. above or below centre, and a total of approximately 39 deg. azimuth. Briefly, via the gunner's control grip, movement vertically or sideways is communicated to the Servo units which, via the 1.5 h.p. electric motor, become power operated to rotate a drum via their respective drives upon which the guns are mounted, thus providing elevation and azimuth. A combination of both elevation and azimuth is possible, and a reflector sight is fitted for each gun. The guns are mounted at the extreme ends of the drum running across the fuselage, and capable of being rotated via a drive from the Servo units, which, in turn, are driven from the motor at high speed. The Servo unit consists of two geared drums revolving in opposite directions, each fitted with a contracting and expanding band. Elevation of the guns by raising or lowering the control grip in turn operates the elevation Servo unit and the bands are thereby automatically applied. Friction on the bands via rods and levers operates the elevation drive to the drum where a pinion meshing with an external rack revolves the drum and so transmits the required elevation up or down. Similarly, by a sideways movement of the control grip the azimuth servo is brought into action, but in this case the external rack on the drum operates an internal rack which, meshing with a pinion, drives the azimuth interrupter gear box. From the sketch in plan view it will be seen that both guns simultaneously can be aligned two degrees inboard or outboard. This is the limit of the synchronised action, after which, due to the action of the interrupter gear box, either gun can be moved independently up to approximately 35 deg. angle outboard.

Although the arrangement has obviously been well schemed and is ingenious, it is doubtful if in operation it is as efficient as British power-operated turrets. Furthermore, the German scheme is extremely complicated, and with the powerful battery necessary to drive the motor, the unit is comparatively heavy.

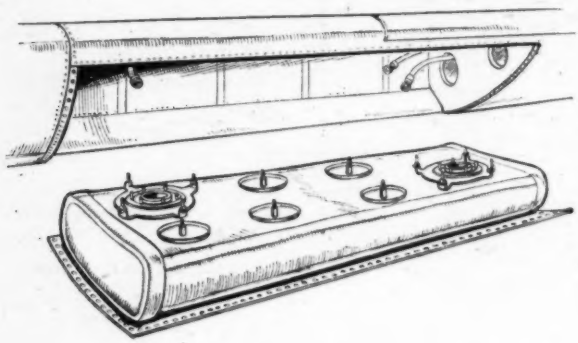
Both the 20 mm. Mauser cannon and the 7.9 mm. machine guns mounted in the nose of the aircraft are fitted with "blast" tubes, which assist materially in cooling the guns. Those fitted to the machine guns extend the whole length of the barrel, but in the case of the cannons they are terminated just behind the muzzle. From the illustration it will be seen that the bombs are carried well forward in the nose of the aircraft below the front gun mountings.

Armour protection, as already stated, is freely distributed over the aircraft, and contributes as much as 900 lb. to the gross weight, a probable result of British fire power. From the sketch it will be noted that all the vital parts

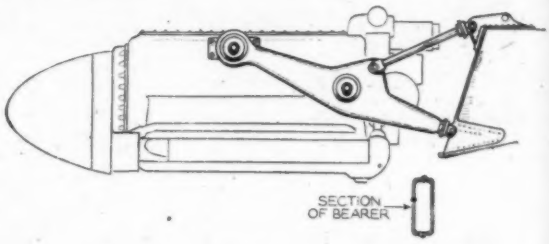


The rear gun mounting. Two 13 mm. machine guns in streamlined "barbettes," one on each side of the fuselage, are sighted and remotely controlled by the rear gunner.

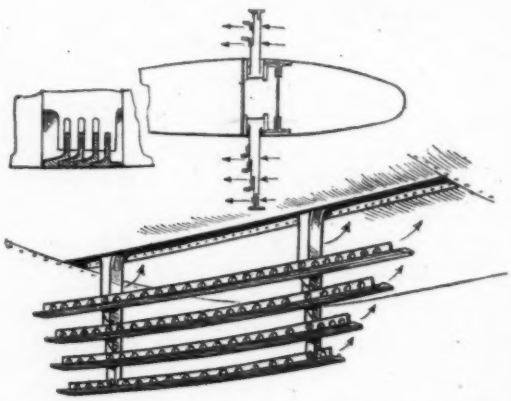
MESSERSCHMITT 210 A-1



The flexible fuel tanks are housed within the wing and slung from the upper skin.



The new type engine mounting consists of a welded box-section bearer in compression with a tubular tie to the top joint.



Parallel-bar diving brakes are fitted. When retracted these are flush with the skin, thus eliminating drag in normal flight.

of the engine are protected, also the engine cooling system. The pilot is exceptionally well screened by armour, both under and at the back of his seat, with additional protection in the nose of the aircraft. The rear gunner is protected by a large bullet-proof glass panel. 2½in. thick, below which is a further armour apron.

Speaking generally, the machine embodies many interesting design features, and, moreover, the construction and workmanship are good. As a dive bomber it may be efficient, but the general layout as a long-range fighter aircraft does not strike one as being equal to British designs of this type. It is estimated that the top speed is in the region of 370 m.p.h. at 18,000ft. The span of the aircraft is 53ft. 9in., length 40ft. 3in., and the all-up weight approximately 21,350 lb.

Our artists obtained the detail sketches from a captured specimen at the invitation of the M.A.P.

CHANGES AT SHORTS

LAST week-end it was announced that Sir John Heaton had been elected chairman and a director of Short Brothers (Rochester and Bedford), Ltd., in place of Mr. H. O. Short, chairman and managing director, who has resigned on account of ill-health. Mr. Short has been appointed president for his lifetime of the company.

The news of Mr. Short's retirement will cause widespread regret in British aviation circles, although scarcely surprise, as his illness was known to most people in the aircraft industry. It is to be hoped that he may long continue to take an interest, less active, perhaps, in the firm which he founded with his brothers, Eustace and Horace, during the pioneer days of flying.

That Sir John Heaton should have been appointed chairman of Shorts seems most appropriate. He is head of the well-known firm of Thomas Tilling, Ltd., whose petrol-electric omnibuses were a familiar feature of London streets some years ago. As duly recorded in *Flight* at the time, when a parsimonious and short-sighted Government "economised" by reducing aircraft orders almost to vanishing point, thereby bringing many aircraft firms almost to the brink of ruin, Short Brothers managed to keep their firm going and most of their workpeople occupied by building very light bodies for buses, making extensive use of aluminium and duralumin in place of steel. Among the companies whose buses had the Short bodies was Tillings, so the association of the two firms is a long and close one.

It would appear that there is little likelihood of history repeating itself after this war, and in this connection it is interesting to record that recently Sqn. Ldr. H. W. McKenna, a director of Shorts, stated that the company had plans for a new 100-ton civil flying boat for civil use, and that its construction immediately after the war was being contemplated.

Another Short director whose resignation has been announced is Mr. A. E. Bibby, whose association with the firm dates back to 1915. "Bib," as he is affectionately called, was in charge of production in the difficult years and during the earlier stages of the expansion period. To him fell the task of finding sufficient workers, and training them, for the large-scale production programme. He can look back on a vast amount of work well done.

NAVY AND R.A.F. CO-OPERATION

AN interesting example of co-operation between the Navy and the R.A.F. is a joint scheme of signalling training recently inaugurated at a Coastal Command station on the West Coast.

"Signalling," said the officer who devised the course, "must be dead accurate. We cannot afford mistakes. Radio silence imposed for reasons of security has made visual signalling of paramount importance. Aircraft fly home in a few hours with secret information which, had it been sent by radio, might well have been picked up by the enemy listening posts. Many a U-boat has been attacked, and many a convoy saved, because of a message signalled from ship to aircraft hundreds of miles out at sea. The airmen are the carrier pigeons of the convoys."

Morning and afternoon, under this scheme, a small party of naval signallers under the command of a yeoman of signals, exchange messages with aircraft circling 1,000 feet above them. As well as giving a training in signals, this scheme enables the aircrews and seamen who work in such close co-operation to get together and exchange notes. The naval men live on the airfield and all personnel finish the course with a much surer understanding of the need for co-operation, its value, and the best way it can be achieved.

SHARE YOUR "FLIGHT"

THE publishers regret that owing to paper shortage it is not possible to satisfy all demands for *Flight*. Accordingly, readers who can do so will perform a useful service by passing on their copies to friends or others who have been less lucky.

Chicago Conference on Cargo Aircraft

CHARACTERISTICS which would be required in the designs of post-war transport aircraft formed one of the chief subjects of discussion at the "air cargo engineering meeting" sponsored by the Chicago section of the Society of Automotive Engineers, which was attended by representatives of the U.S. Army and Navy, the Civil Aeronautics Administration, airline operators and manufacturers. The meeting was, in fact, regarded as of considerable significance in American aviation, since never before had such a representative group gathered together to discuss and consider air cargo.

Naturally enough, a wide range of opinions was expressed during this two-day meeting, but there was at least one point upon which everyone agreed, namely, that post-war air transport would not seriously threaten the railways nor the shipping companies; although it certainly had a great future, it would be, in the words of Eric Bramley, "a part of the overall transportation picture." Nevertheless, it was admitted that air transport would inevitably offer some degree of competition with surface transport, but opinion was again divided as to what extent the competitive factor would operate in practice.

One point upon which there was diversity of opinion under the heading of design related to the precise function which the post-war transport aircraft should be required to fulfil. Some favoured a combination of passengers and cargo and others thought in terms of the all-cargo aircraft; some thought that military transports would play their part in post-war developments, but others held to the view that almost all military flying equipment would be unsuitable.

Chief among the speakers were Carlos Wood, of the Douglas Aircraft Co., who naturally looked at the problems chiefly from the manufacturers' viewpoint, and Charles Froesch, chief engineer of Eastern Air Lines, who approached the subject from the angle of the operators.

Mr. Wood was one of those who believed that there was little or no difference between the job of carrying military loads and peacetime freight. "Common-sense design of good military cargo aircraft," he said, "will produce efficient aircraft types for future use in peacetime." Mr. Froesch did not necessarily contradict this point of view, but he *did* say that, in his opinion, the ideal cargo aircraft had yet to be built. The most suitable type, he thought, would be a two- or four-engined high-wing aircraft with tricycle undercarriage.

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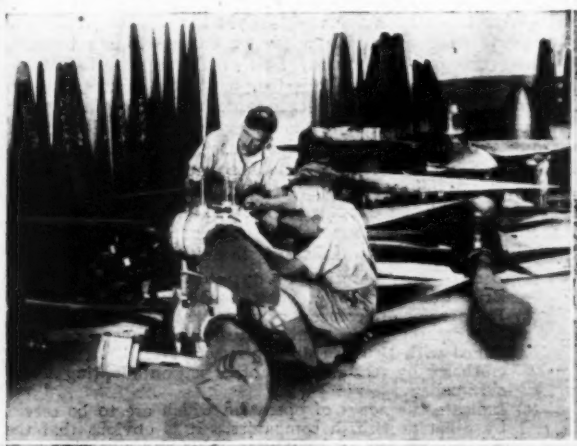

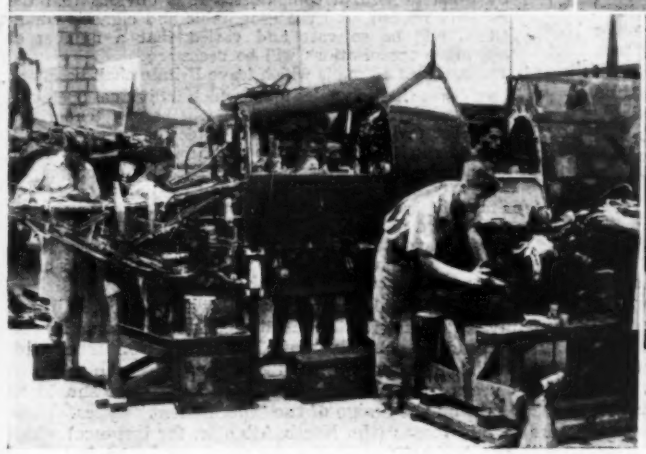

MALTESE MAINTENANCE. One of the biggest problems in the Battle of Malta has been the repair and maintenance of aircraft, particularly of fighters. British and Maltese mechanics work side by side to keep the maximum number of machines serviceable. Top left: Rotol and de Havilland airscrew being reassembled. Top right: Overhauling tropicalised Spitfires. Bottom left: Re-erecting Spitfires. Note the bullet hole patches on the fuselage where a pilot had a narrow escape. Bottom right: A Bristol Pegasus radial down for overhaul.

"Wanted"—An Air Charter

Some Thoughts on the Planning of Post-war Aviation: The Need for a Government Lead: Bringing Operators and Manufacturers Together

WITH so many sections of the community now taking a keen interest in the subject of post-war civil aviation, including the formation by the Association of British Chambers of Commerce, the Federation of British Industries, and the London Chamber of Commerce of a joint committee under the chairmanship of Mr. Oliver E. Simmonds, as announced in *Flight* last week, and a Government Departmental Committee under the chairmanship of Lord Brabazon, it appears more than ever necessary that at least the broad outlines of British policy should be established. Before any headway can be made it is absolutely essential that the Government should give a lead as to the basic policy, and we therefore welcome the support given by the Simmonds Committee to the suggestion which we made some months ago that a Parliamentary standing committee should be formed.

While discussions are still in an early stage, it appears desirable to note certain fundamental considerations which must be taken into account if our planning is to proceed along the right lines. During informal discussions we have had with people in many walks of life, we have had many opinions expressed to us. Among those with whom we have talked about this very complicated question of post-war civil aviation are the leading people of the De Havilland Aircraft Company, Ltd., who have had greater experience in designing and building civil aircraft than any firm in the country. From our talks certain considerations and conclusions have emerged, which may serve as a useful basis for further discussions.

First of all it must be realised that only the War Cabinet and, to a more limited degree, the Air Staff can know to what extent the country can afford to deflect productive capacity from bomber to transport aircraft.

Largely owing to her geographical conditions, America is already in large-scale production with military transport aircraft, and we in this country can scarcely hope to emulate her example in the circumstances in which we find ourselves.

Interim Period

The conclusion appears inevitable that when fighting ceases there will be an interim period in which converted bombers and military transport types will have to be used extensively. Obviously, American aircraft will be in the majority on the world routes during that period. That, however, is no valid argument against beginning now with the planning of the more permanent airline organisation which must in time replace the interim arrangements.

At this point it appears worth while to look back and to try to draw from past experience certain lessons which might usefully be applied to future planning.

There appears to be an almost unanimous demand for airline competition. Not the sort of wasteful competition which did so much harm in the early days of commercial flying, but at least sufficient competition to ensure efficiency. If there is one thing which the first two decades of commercial aviation (1919-1939) has taught us it is that monopolies are basically unsound, whether they are held by commercial enterprise or by the State.

It should be possible right away to decide on two or three main transport types of aircraft which would, with relatively minor modifications, be fairly suitable for certain routes, the operation of which is inevitable in any post-war scheme. It is undoubtedly a fact that for any long-term policy it will be absolutely essential to use aircraft types specially designed for and fully suited to the particular route. Such types cannot be designed to any "general" specification, but must be the outcome of close and direct collaboration between the practical operating companies and the practical aircraft manufacturers. The task of the Government will be to create a demand for aircraft, not a number of aircraft that are not wanted. Given a clear-cut issue, the British aircraft industry can be relied upon to turn out aircraft of the right quality.

Early Start

The great thing will be to get British air transport started as early as possible, and on a large scale, so that the operating organisations can be built up, the personnel welded into efficient teams, and practical experience accumulated. There need be no misgivings about using American aircraft at first, should that be necessary. Experience is what counts, and there will be available, for example, British aircrews and ground personnel with the very finest training. Our large shipping companies have an accumulated experience of transport which, applied to air transport, should prove invaluable. And radio developments which owe their existence to the war will become available for application to commercial flying. They should make an invaluable contribution to safe and efficient air transport.

With these principles established and accepted, the question that arises is how far we can go to-day towards laying the foundations for British air transport. If we could decide at once who is to operate the routes, and on what terms, the chosen companies could begin to collaborate with manufacturers in evolving suitable aircraft types. But we have not at present the answers to certain questions which must precede such detail planning. For example, is commercial aviation to be internationalised?

Thus again the conclusion is reached that the Government must declare our basic air transport policy. This might be done on the following lines:—

(a) Declare our intention to operate, over stated routes, British air services second to none.
(b) Declare our preference for unsubsidised development, but our determination that British air services (possibly linked with British shipping services) shall not suffer in efficiency by reason of any other nation adopting a subsidy policy.
(c) Indicate the zones of operation which are to be served by different British companies. It is obvious that the network needed, and the geographic and climatic conditions, will be so vast and varied that a number of operating organisations will be necessary.
(d) Declare that all mails which leave Britain shall be flown.
(e) Lay down the principles upon which individual operating licences are to be granted (i.e., whether by tender and for what period). This would enable the interests qualified to run these services to prepare their own policies.
(f) Define who shall be responsible for weather reporting and forecasts, radio, traffic control and all ground services.
(g) State the broad policy for the replacement of the aircraft types used during the interim period. For instance, the Government might insist that after a certain period, say, four years from the signing of Armistice, all British airlines must operate British aircraft only.

There will probably be plenty of war transport aircraft (mainly American) for the interim period, and some British types could be quickly put into production if needed. Meanwhile, bearing in mind that it will take at least three years to get into full production, a start should be made now on the design of the "permanent" types. There are certain routes (the North Atlantic, for instance) which will obviously have to be operated, and the length of stages and volume of traffic are pretty well known already.

The best hope for an immediate start would appear to lie in finding a type, or types, sufficiently alike in their requirements to serve with but minor modifications for wartime military transport and post-war civil transport.

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GENERALLY accepted as the easiest of all aircraft to recognise, a wit once said that aircraff were, in fact, divided into two main classes—Lysanders and other aircraft.

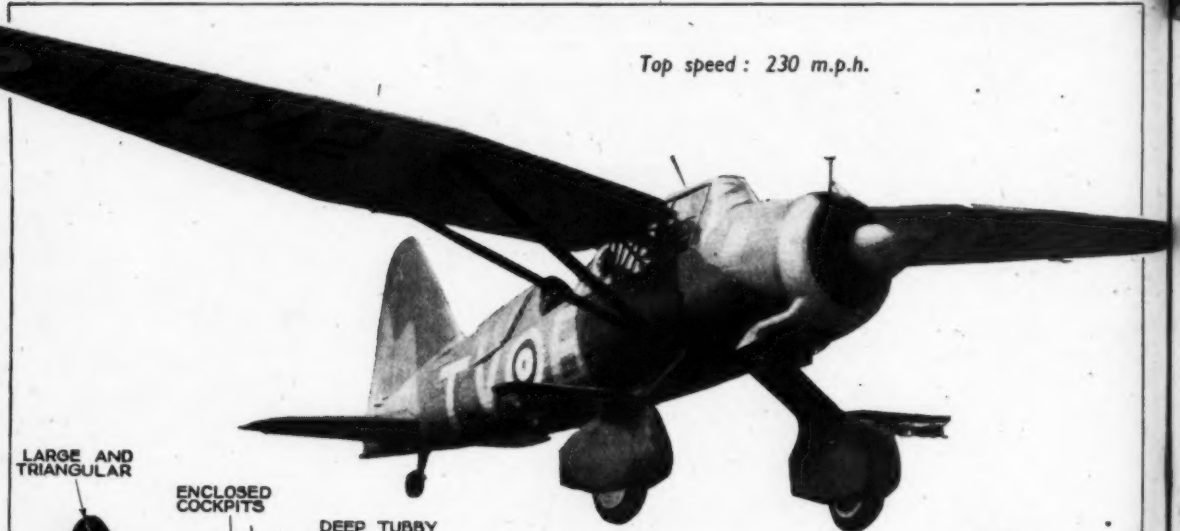
Designed specially for Army Co-operation Squadrons, the prototype appeared in 1936 and was fitted with an 890 h.p. nine-cylinder Bristol Mercury XII engine, but it was not until three years later, early in 1939, that the first production Lysanders, also powered by Mercury XIIs, were actually delivered to the squadrons to replace the Hawker Hector biplanes then in service.

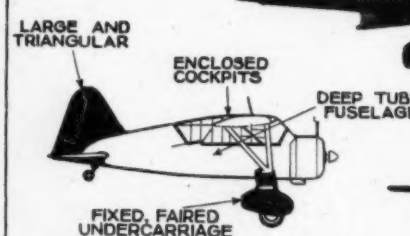
The Lysander II, however, has a Bristol Perseus XII nine-cylinder, sleeve-valve, air-cooled radial engine of 905 h.p. which, although of the same bore and stroke as the poppet-valve Mercury XII, has a slightly greater overall diameter and is slightly heavier. The sleeve-valve Perseus gives the Lysander II a top speed of 230 m.p.h. at 10,000ft., a speed at sea-level of 206 m.p.h., and a service ceiling of 26,000ft.

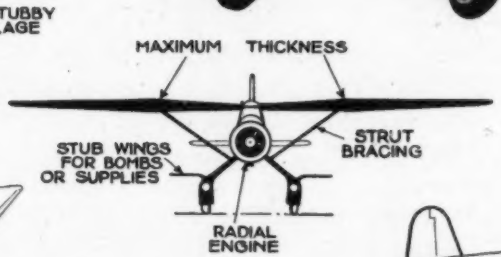
Equally important in any Army co-operation aircraft, however, are the minimum flying speed and the landing and take-off run, since under active service conditions it is only too likely to be called upon to operate from small temporary flying fields, or even from fields that are not really "flying-fields" at all. The Lysander, with its fully slotted and flapped wings of distinctive shape, can fly as slowly as 55 m.p.h., fully laden; it can clear a 50ft. obstruction in 245 yd. from beginning its take-off run and, when landing, can come to a standstill on the ground in 330 yd. from a height of 50ft.

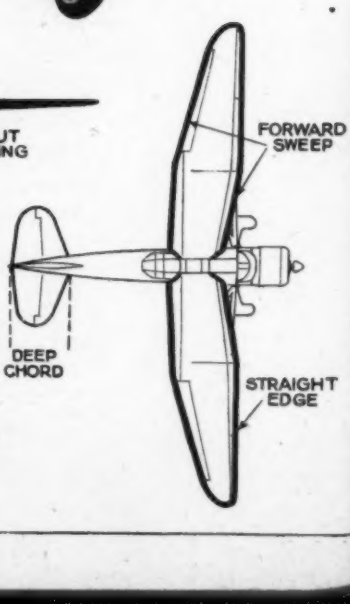
Although the technique of Army co-operation has been extended in the light of war's experiences, and other types of aircraft (such as the Mustang) have been found more suitable for certain duties hitherto entrusted to the Lysander, the latter is still an extremely useful aircraft in many ways and is employed on all kinds of missions when enemy fighters are not likely to be encountered; it is, for example, doing admirable work with the Air/Sea Rescue Service.

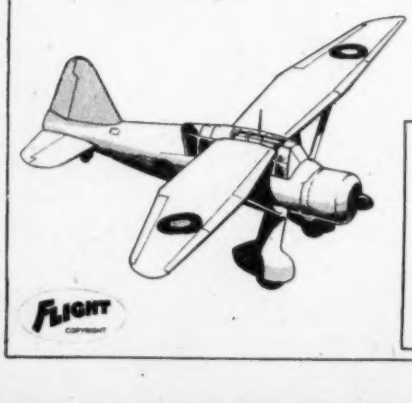
Its armament consists of a pair of fixed machine guns mounted in the wheel fairings, and twin flexible guns on a Fairey mounting in the rear cockpit. The stub-wings on the undercarriage legs, which are detachable, can carry either eight small bombs or supply containers.











DIMENSIONS OF LYSANDER

Span	50ft.
Length	30ft. 6in.
Height	14ft. 6in.
Wing Area	260 sq. ft.

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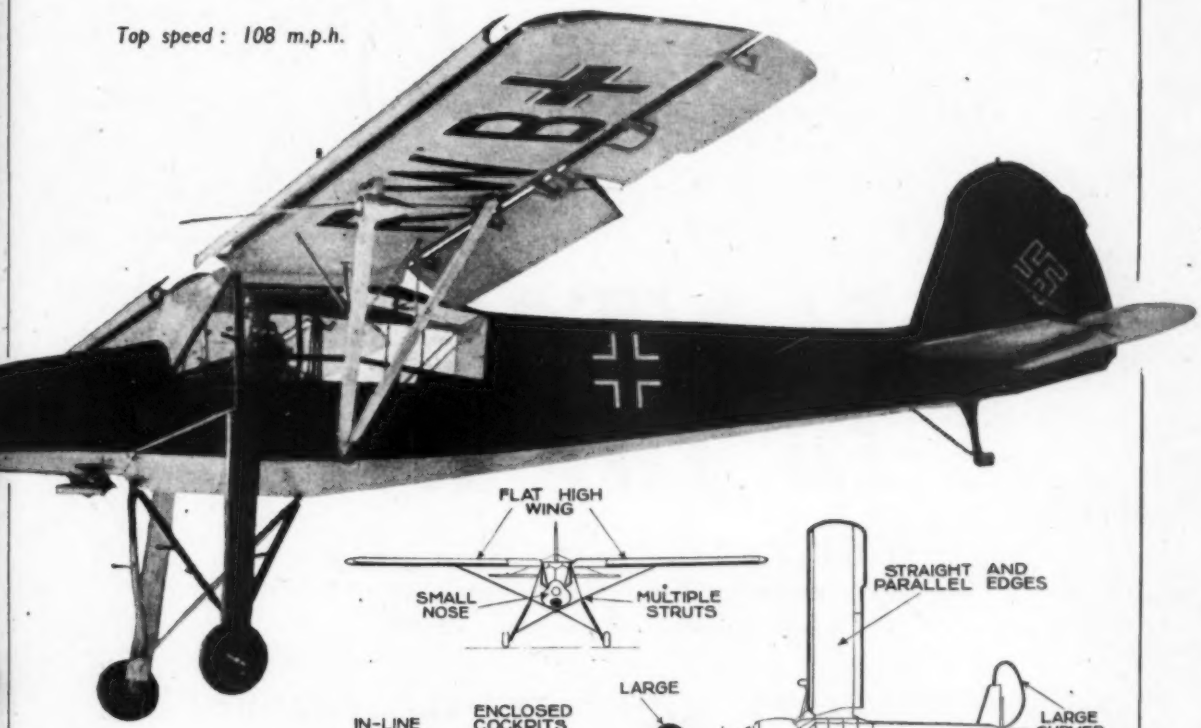
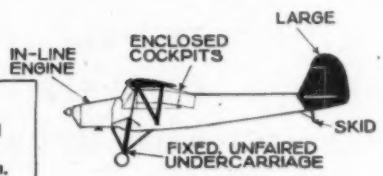
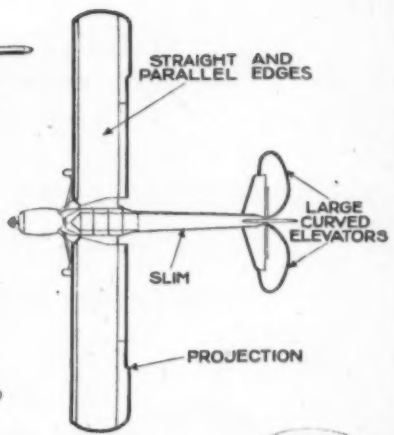
FIESELER STORCH







DIMENSIONS OF STORCH

Span	46ft. 9in.
Length	32ft. 6in.
Height	10ft.
Wing Area	279.7 sq. ft.

ALTHOUGH a strut-braced, high-wing monoplane with fixed undercarriage, the Fieseler Storch must not be looked upon as the German counterpart of the Lysander—a role more suitably filled by the Henschel Hs 126.

The Storch, though it has a slightly greater wing area and is 2ft. longer than the Lysander, is less than half the weight of the British machine and can carry less than half its load. It is primarily a light communications type and has been quite extensively used by the Germans for this purpose in the Middle East; one of Rommel's generals, it will be recalled, was forced down and captured while "making his rounds" in a Storch, and no doubt Rommel himself frequently used one in Egypt and Libya, though perhaps this machine is hardly fast enough for him now!

¶It is normally powered by a 240 h.p. Argus As.10C eight-cylinder, inverted "V" type, air-cooled engine, but other engines of comparable size can be and sometimes are, fitted. Top speed is very low for the horse-power, being 108 m.p.h., but with it goes a minimum level flying speed of 31 m.p.h., a landing speed of only 25 m.p.h., and a landing run, using the brakes, of 30 yd. at most! It is, in fact, about the nearest approach in behaviour to an autogyro that anything with fixed wings could well achieve, especially when one remembers that the above figures are for still air; incidentally, its service ceiling is 17,000ft.

This slow-flying and very short landing is the result of fixed slots along the entire leading-edge and slotted, camber-changing flaps, plus a very light wing-loading of only 9.94 lb./sq. ft., with a rather high power-loading of 11.6 lb./sq. ft. Movable slots may be fitted, however, with a consequent reduction in drag and some increase in top speed. Its only means of defence is a single machine gun on top of the fuselage behind the cabin.

The Storch is fairly easy to recognise from other strut-braced, high wing aircraft, for it has three predominating characteristics each of which shows up well in front view, side view and plan respectively, namely, the stork-like legs of the fixed undercarriage, which may have suggested its name, the large fin and rudder, and the unusually shaped elevators, which leave a deep "bite" in the curved trailing edge, and which project well beyond the small area of the fixed tailplane. The projection formed by the extended area of the elevators will also be seen.

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Aircraft Gun Control Systems

Pneumatic Operation Light and Simple : The Need for Selector Units: Pioneer Work by the French

By H. G. CONWAY

EARLY machine guns fitted to fighting aircraft were manually controlled or fired by the rotating airscrew. In some cases simple mechanical remote controls were used to operate a gun in the nose of the aircraft out of reach of the pilot or gunner. The introduction of the multi-gun — or cannon aircraft — brought a new problem: the firing control of the guns relatively far away in the wings.

Certain machine guns such as the Browning used on modern British fighters require merely the pulling of the trigger once loaded up, a simple pneumatic jack on the gun being used. A single button on the control column admits air to all jacks, thus firing all guns simultaneously. In the event of a cartridge jamming or misfiring, the gun cannot be reloaded in the air and remains out of action.

Operational Requirements

In the case, however, of the mixed gun or cannon fighter, the control system cannot be so simple. The machine guns are usually focused, say, 300 yards ahead of the aircraft, and the paths of the bullets being divergent beyond this point, the effectiveness of the fire is lost beyond about 400 yards. This focusing effect gives the equivalent of "depth of focus" in photography. The cannon, however, can fire in parallel or be focused at a much greater range.

If all guns and cannon are fired at once by a single button, considerable wastage of ammunition may occur. It is useless, for instance, to fire six machine guns at the same time as four cannon when attacking tanks, small ships or heavily armoured bombers. It may be equally wasteful to shoot up reconnaissance aircraft, troops in open country, gliders, etc., with cannon when machine guns would do, and the cannon ammunition needed for more serious work. Consequently, some means of selecting the guns to be fired is required.

The most obvious method on an aircraft such as the Beaufighter, with a mixture of machine guns and cannon, would be to provide two trigger buttons on the control column such that either one or both could be pressed and elementary selection of the guns or cannon effected. This system is, in fact, used. However, this may not be enough in certain cases. The Beaufighter is now fitted with a selector allowing any one of its four cannon to be fired at will, thus allowing the maximum use of the relatively limited amount of ammunition, and avoiding wastage.

The gun trigger on the spade grip of an eight-gun Spitfire. All guns fire on pressing the button, there being no provision for selecting groups of guns.

The Fw 190, which presumably represents the latest German viewpoint on the problem, is equipped with a number of mixed guns—two machine guns, two 20 mm. Oerlikon cannon, and two 20 mm. Mauser cannon, firing through the airscrew. A selector is provided allowing either all guns, or the two Oerlikon cannon, or the machine guns and synchronised Mausers to be fired.

Future Armament

The four-cannon Spitfire and Hurricane, however, have no selectors, being primarily defensive weapons, and unlikely to carry out excursions calling for varying types of fire. The whole policy in their armament is to be able to produce the maximum weight of fire at once.

It is reasonable to suppose that in future designs of fighter, at any rate on the two-motor long-range type, armament will be even heavier. Possible equipment in the not too distant future would be six machine guns, four 20 mm. and two 40 mm. cannon. The first two would be for general work as at present, and the two heavy shell guns would be effective for tank or flak-ship "busting." In an aircraft equipped in this manner the need for selection is even more obvious.

Control Systems

As mentioned above, the existing British system for firing 8 or 12 machine guns is a simple button-controlled pneumatic one. An air bottle at a pressure of 200-300 lb./sq. in. provides the air supply. The 20 mm. cannon such as the Hispano is generally provided with three controls: (1) Loading or cocking control, pulling back the bolt to admit a shell; (2) fire control, pulling the equivalent of a trigger; and (3) safety control, locking the gun trigger mechanism by a safety catch. Other and larger cannon will require similar controls. These functions can be carried out by any of the usual remote control systems, but special systems have been developed with particular efficiency. Mechanical controls would be heavy and require considerable effort to operate several guns at once. Electrical controls are used in U.S.A. and in Germany (e.g., on the Fw 190), but the solenoids are heavy and bulky. They have one notable advantage in that they are not directly susceptible to freezing at high altitude. Selection is relatively simple with a multiple switch block.

Hydraulic controls have been tried, but they have not been successful. It is a relatively easy matter to apply hydraulic pressure rapidly, but very difficult to remove the pressure and oil from an operating jack equally rapidly.

Pneumatic controls have been used for a number of years and, in spite of early fears that trouble would be experienced due to moisture freezing at high altitudes, have proved extremely reliable. In order to overcome the supposed difficulty of freezing, which occurs when the air is expanded down an operating pipe and

AIRCRAFT GUN CONTROL SYSTEMS

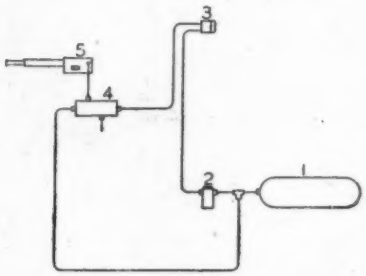


Fig. 1—Diagrammatic representation of pneumatic gun control system. 1 is an air bottle, charged to 450 lb. per sq. in., 2 a reducing valve which reduces the pressure from 450 to 150 lb. per sq. in., 3 is the trigger button, 4 relay, and 5 the gun.

cools sufficiently to deposit moisture on the inside walls of the pipe and mechanism, a relay system has been proposed and tried, but not found necessary in practice. This system and the operation of the relay are shown diagrammatically in Figs. 1 and 2.

Close to the jack on the gun, and in a relatively warm spot, is the relay. When the pilot presses his button he admits low-pressure air from the bottle, via a reducing valve, to the relay. This then admits high-pressure air direct from the bottle to the gun jack. The amount of moisture evolved by the expansion of high-pressure air between relay and gun is small and not likely to freeze. As there is only low-pressure expansion down the pipe between trigger button and relay and no expansion down the other high-pressure pipe, there is little likelihood of freezing troubles in them.

Electro-pneumatic controls have also been proposed similar to the above with electric control means in

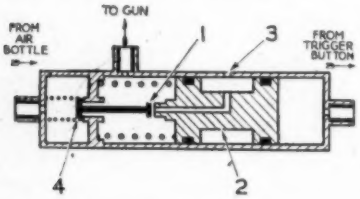


Fig. 2—Operation of the relay. Normally the gun jack is open to the atmosphere as the valve, 1, is open. Any air in the jack escapes through the hole in the piston, 2, and out of the port, 3. When low-pressure air from the trigger button arrives at the relay, the piston, 2, moves to the left, first of all closing the valve, 1, and opening the valve, 4, thus admitting high pressure from the air bottle to the gun jack. When the trigger is released, a spring moves the piston in the other direction, shutting off the high pressure and releasing the gun pressure to atmosphere once again

place of low-pressure air, and regulating the admission of high-pressure air to the guns on or near them through small solenoid-operated pneumatic valves. These at first sight offer the advantage of simplicity of electric control and switch-selection without the disadvantage of the excessive weight of a pure electric system.

Selection Applied to Pneumatic Systems

The French may be said to have developed the first pneumatic gun systems incorporating selectors. This may have been brought about by their early use of the Hispano cannon with or without attendant machine guns, leading to a logical desire to select. The armament of the French fighter of ten years ago—two machine guns and one cannon—may appear poor by present standards, but the same problems were present in their control as on a modern machine.

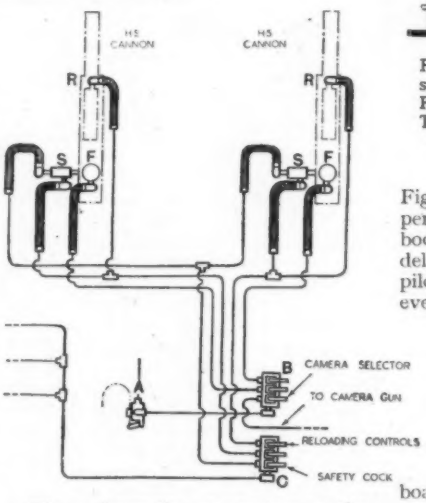


Fig. 3 shows the gun system on the Potez 63 (1934); Fig. 4 that on the Bloch 151 (1937). The selectors on the first system consist of two separate banks of triple valves, lever-operated. One has three spring-loaded levers which, when pressed down, reload the two cannon or effect general safety by admission of air to the corresponding jacks on the cannon. The other has three levers with two positions. With a lever upright that gun is isolated; when down, it is in action. The firing relay is operated by a Bowden cable from the pilot's trigger, this taking the place of the low-pressure system of Fig. 1.

The Bloch 151 system is a later type with an improved selector unit. The actual selector is shown in

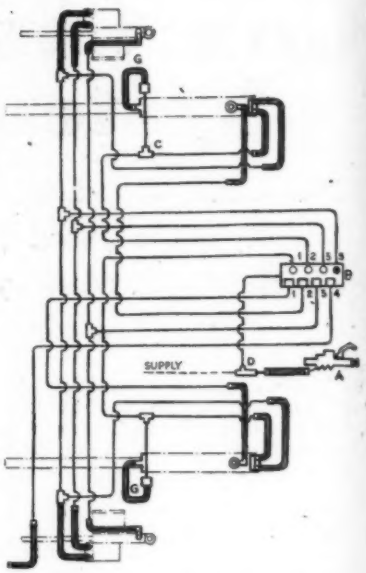


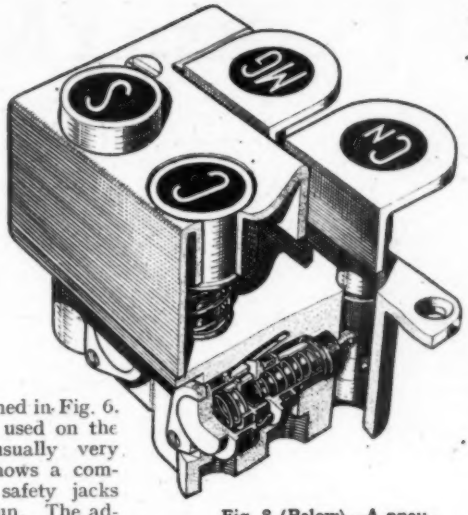
Fig. 3—(Left) The pneumatic gun system, with selectors, on the French Potez 63 of 1934. Fig. 4—(Above) The 151 system of 1937 is a later type, with improved selector unit.

Fig. 5, and combines the functions performed by the two triple valve bodies in the Potez 63. The unit is deliberately made large enough for a pilot with gloved hands to operate even in the dark, and the buttons are luminously engraved. The four flat keys on the front of the unit, when pushed down, permit firing of the respective guns or operation of the camera. In this particular system the left key controls the port cannon, the second from the left the starboard cannon, the third both machine guns, and the right-hand one the camera. The three left-hand buttons

Fig. 5 — The selector unit of the Bloch 151 combines the functions performed by the triple-valve bodies of the Potez 63.

at the back are spring-loaded, and when pushed reload their respective cannons or guns. The right-hand button is taller than the others to make it easily distinguished by touch, and effects safety blocking of all guns. In this system no relays are used, the guns being operated directly by high-pressure air.

The internal construction of a double selector unit of this type is shown and explained in Fig. 6.



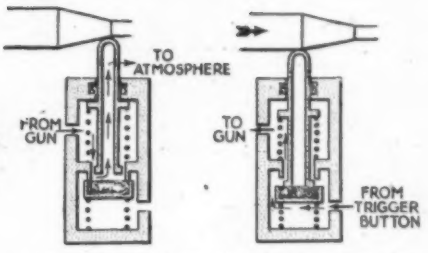


Fig. 6 (Left)—A double selector unit or the Bloch 151 type, shown part-sectioned.

Fig. 6A (Above)—The operation of the unit shown in Fig. 6. In the diagram on the left the selector is closed, the gun jack is connected to atmosphere, and the air supply from the trigger button is isolated. In the right-hand diagram the selector is open, and the gun jack is in communication with the pipe line from the trigger button.

The pneumatic jacks used on the guns themselves are usually very simple units. Fig. 7 shows a combined pair of fire and safety jacks for a Hispano 20 mm. gun. The admission of air to the firing jack pulls down the "bent" or member which on a rifle is normally operated by the trigger, and allows the striking pin to fire the shell. The safety control moves a pin across to lock the firing jack piston rod. Release of this catch is effected at the same time as reloading when the reloading button on the selector is pushed, by air being admitted to the safety jack as well as to the reloading jack, to move it in the other direction.

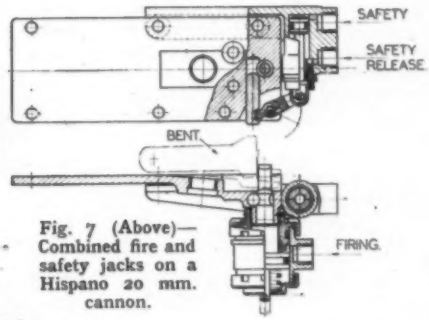


Fig. 7 (Above)—Combined fire and safety jacks on a Hispano 20 mm. cannon.

In order to improve efficiency at low temperatures when the oil used to lubricate the glands of the jacks may become sufficiently thick to make operation sluggish, a further improvement can be made. This is shown in Fig. 8. Glands on the piston are omitted, a fine fit between cylinder and piston being sufficient to allow movement, without any possibilities of sticking, and sealing against pressure loss takes place only at the end of the travel of the piston on an end seal.

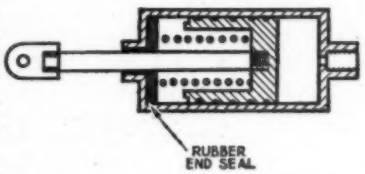


Fig. 8 (Below)—A pneumatic jack with glandless piston.

Book Reviews

Paratroops. By Captain F. O. Miksche (with a preface by Captain Liddell Hart). Faber and Faber, 10s. 6d.

CAPTAIN MIKSCHE is a Czechoslovak officer attached to the French Forces, and he has written what is apparently intended to be a textbook on airborne troops. He has based his book on German methods and achievements in Norway, the Low Countries, Greece and Crete, which he recounts in considerable detail.

All books written during a war suffer from the disadvantage that things are liable to advance in the interval between the writing and the publication. So recently as the first week in December, 1942, a *Flight* representative was allowed to visit a British airborne division, while British airborne contingents have been in action in Northern Africa. The British leaders have developed ideas of their own, and they do not always coincide with the maxims which Capt. Miksche has laid down. For one thing, he enjoins that the object of the expedition must be kept a secret from the troops, which was the German method; British leaders take the officers and men into their confidence, so that each private knows beforehand exactly what he has to do.

However, some of Capt. Miksche's ideas are interesting. He advocates that landings must be made within the range of fighter cover, which must mean short-range fighters. He would confine the use of gliders almost entirely to the conveyance of equipment, sending troops in power-aircraft. Most of his suggestions for the use of airborne troops (i.e., in attack, in pursuit and in defence) are fairly obvious.

Like some other Continental writers, Capt. Miksche has no sort of understanding of sea-power. In his account of Crete he makes the amazing misstatement: "The British Naval force assisting the operations on land was put out of action by the German air force without much difficulty." Again, in the same chapter: "There (Crete) the three fighting forces of the enemy—air, sea and land—worked in perfect co-ordination." What did the German Navy do at Crete?

The author also discusses the chances of an invasion of Britain, led by airborne troops, and stresses the need for the German navy to play its part. That implies German command of the sea.

Likewise this author does not understand our Royal Air Force. He says that an air force in which a sharp division is drawn between Fighter and Bomber Commands can never lend to ground forces that total dynamic support which is necessary. We may point out that, first in the Battle of France and lately in the Middle East, the aircraft engaged have not worked, and do not work, under separate Bomber and Fighter Commands.

This is a thoughtful book, not easy to read, but we doubt if it will be of much service to the leaders of British airborne divisions.

The Battle of Egypt. Prepared for the War Office by the Ministry of Information. 7d. net.

THIS publication is described as the official record in pictures and map, and it is extraordinarily good value for the trifling price. There is a very concise description of the course of events, but in the main the excellent photographs are left to tell their own story. It seems to us that not enough attention is paid to the Air Force side of the battle. It is not, of course, entirely neglected, and there are several pictures of bombs bursting and a few showing captured or crashed German aircraft. Mitchell bombers appear in one photograph and Hurricanes in another, but armour and infantry monopolise most of the interest. They well deserve all the credit which can be given to them, but we think that the work of Air Vice-Marshal Coningham's squadrons should have received rather more adequate attention.

M. I. P. Smyk

One of the Last Polish Light Planes, Designed and Built by Students of the Technical University of Warsaw

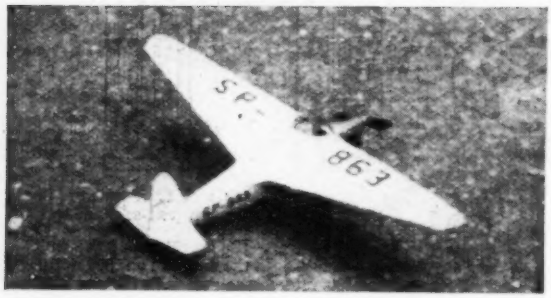


Fig. 1. Even in model form the clean lines of the M.I.P. Smyk are apparent.

By J. P.

THE tragic end of the heroic struggle which the Polish army put up against the German invader, in September, 1939, is still fresh in our minds. German successes in this campaign were achieved mainly because of the numerical superiority of their air force which, by terrific blows, disorganised the defence system of Poland and also wrecked communications, making it impossible to deliver the necessary supplies to the troops. Two questions present themselves: "Why did the Polish government apparently not foresee this possibility?" and "What was the reason for the weakness of the Polish Air Force?"

Poland, demolished during the Great War, had completely to rebuild her towns and villages and organise from scratch her industries, communications, social services, army, etc. This was an enormous task, and more was done than would be conceived possible during a period of twenty-five years.

From the first day of her regained independence, Poland realised that sooner or later a day of reckoning must come to settle various matters. The natural resources of Poland provided most of the materials necessary for war production, but some raw materials had to be imported. In case of war, the geographical position of Poland would make communications with outside sources of supply very difficult. For this reason, the Polish war industry was planned and built to become increasingly independent of foreign sources of supply. Being a poor country, she was compelled to obtain money by exporting her own products.

When the Reich, by its aggressive political movements and increasing war industry, made it clear that war was approaching, the Polish government was faced with the problem whether to change its policy and start to produce arms solely for internal use, or whether to continue its export policy. Lulled by the ten years' non-aggression pact with Germany the Polish government decided upon the latter course.

Showing the World

An illustration of Polish technique was given at the last International Exhibition in Paris, in 1938, where Polish factories displayed a whole range of modern military aircraft. In the effort of war preparations, a very important part was played by the large numbers of experts produced by a splendid educational system.

The Technical Universities of Warsaw, Lwow, and Gdansk (Danzig) had special aeronautical sections, in which students produced projects of designs of engines, aircraft and gliders, many of which were actually built and tried in flight. These enterprises resulted in quite a number of very successful aircraft, such as the famous R.W.D., which twice in succession gained for Poland first place in very severe international competition flights round Europe. (Challenge 1934 and 1936). Gliders built by students played a great part in the development of this sport, and brought Poland into a prominent position in this respect.

This article describes one of the last efforts of the students of the aeronautical section of the Technical University of Wawsaw. It was a low-power single-seater of wooden construction, called M.I.P. Smyk, and had a remarkable performance. Complete wind tunnel tests were made by the Aeronautical Institute in Warsaw. The purpose was to achieve the best possible performance, by reducing to a minimum the parasite drag, while using an engine of really low power. From the point of view of maintenance, the idea was to give glider pilots an intermediate type to facilitate their training as power pilots.

From among the engines then on the market, the Scott Flying Squirrel was chosen. It was a two-stroke, two-cylinder inverted engine developing 16 h.p. at 3,200 r.p.m. and 21 h.p. take-off power at 4,000 r.p.m. The choice fell upon this engine, in spite of its weight per h.p. being rather high, because of its compact form and the possibility of streamline mounting in the fuselage. To reduce the parasite drag to a minimum, the designers provided a retractable undercarriage and a cockpit cover which constituted the contour of part of the wing. In the original drawings even the tail skid was designed to be retractable.

CHARACTERISTICS.

Engine power	16 h.p.
Span	33ft. 10in.
Length	20ft.
Wing area	106 sq. ft.
Total Weight	685 lb.
Weight of empty aircraft	430 lb.
Wing Loading	6.44 lb./sq. ft.
Aspect ratio	11
Safety factor of wing	8
Power loading	42.8 lb./h.p.

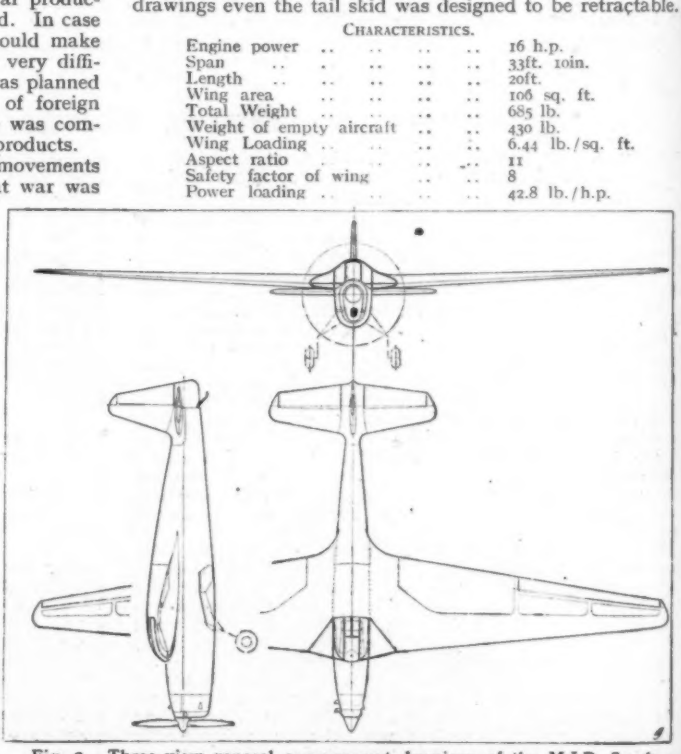


Fig. 2. Three-view general arrangement drawings of the M.I.P. Smyk. The engine was a British Scott Flying Squirrel.

M. I. P. SMYK

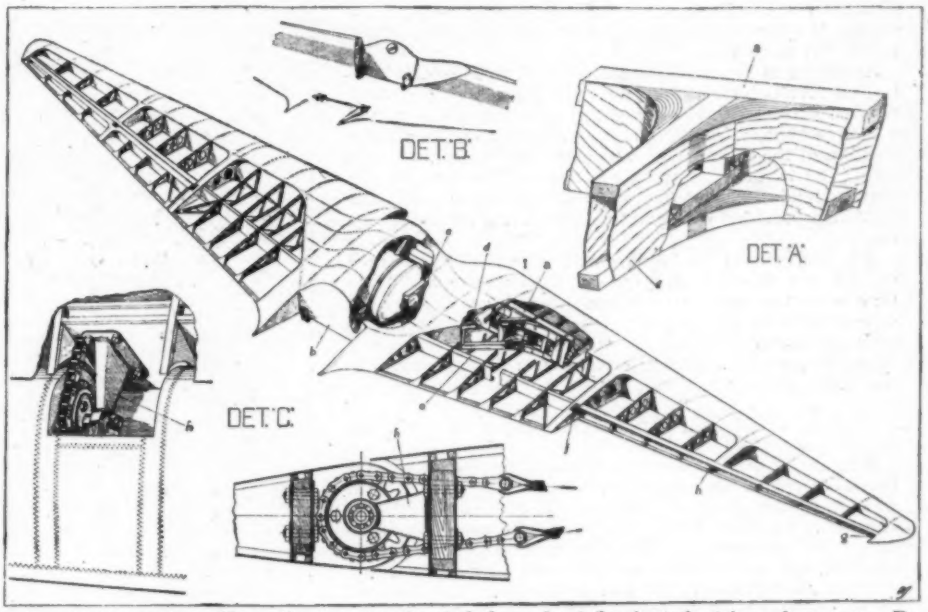


Fig. 3. The wing was a single-spar structure with leading-edge torsion box. The details are described in the text.

The aerofoil used on the wing was Clark Y.H. with a comparatively stable c.p., which permitted the use of a short fuselage and comparatively small tailplane. The wing construction was based upon a single spar of box section. (Fig. 3a.) The part of the wing in front of the spar was covered with plywood and formed the torsion box.

The pilot's cabin was situated just in front of the spar, thus necessitating the cutting of the torsion box in the centre. Here, therefore, the torsion box was formed by the short rear spar (b), two strong ribs (c) and two diagonal spars (d). The centre section was ply-covered and faired into the fuselage lines. The ailerons were mounted on light intermediate spars (e). The trailing portion of the wing was fabric covered, except at the ply-covered centre section. The tank, containing fuel for three hours' flight, was placed in the centre section of the wing. The wing was attached to the fuselage by four fittings (detail B). The connection of the diagonal spar to the main spar was rather original (detail A).

To obtain the transmission of stresses in the most efficient direction of the grain of the wood, the corner blocks were constructed from bent laminated strips of spruce. By this means, good gluing surfaces were obtained, i.e., the gluing was maintained at a small angle to the grain of the wood. The aileron hinges were placed on the ends of the ailerons (Fig. 3 f and g) and another (h) in the middle. At the middle hinge a sprocket was fixed to the aileron and control was by a chain (detail C). The middle hinge was attached to the bracket (h) and the end hinges (f) and (g) were mounted to the wing ribs.

Of particular interest was the cockpit cover, since it was really a transparent continuation of the centre section of the leading-edge portion. In every longitudinal section the cockpit cover completed the actual aerofoil, thus causing no increase in parasite drag. The view was very good in all directions, and particularly during landing, thanks to the transparent panels covering the bottom surface of the cut-out.

The cockpit cover (Fig. 4a) was hinged on two swinging arms (b) and was provided with two locks on the leading edge. In case of emergency, the whole of this could be jettisoned. The opening was operated by an upwards and backwards hinging movement, as shown in Fig. 4.

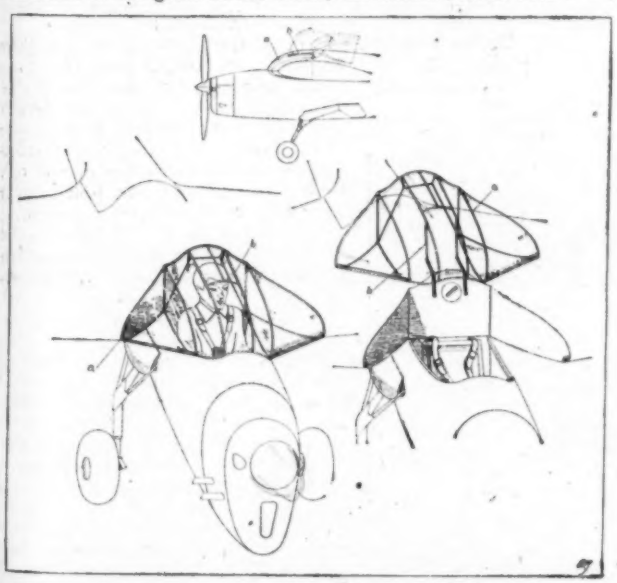


Fig. 4. The cockpit cover showed traces of glider influence, being a continuation of the centre-section leading edge. It could be jettisoned.

Monocoque Construction

Of monocoque construction, the fuselage was covered with plywood. The oval frames of the fuselage were of box section. The central part of the fuselage contained a space provided for the retracting of the undercarriage, which was supported by the main bulkheads (Fig. 5, a and b). In front of the bulkhead (b) the fuselage contained a comfortable pilot's cockpit. The engine mounting was attached at four points to the front frame protected by a fireproof bulkhead.

The undercarriage (Fig. 5) contained some very interesting features. Two separate legs (c) were hinged to the frame (d) along two axes at an oblique angle. The legs contained the shock absorbers, consisting of rubber rings. Dunlop low-pressure tyres were used, of 350 mm. diameter. The legs were stiffened by "breakable" connecting rods (e) which were connected by the tubes (f) to the slide (g), operated by chain transmission from the handle (h)

M. I. P. SMYK

placed on the right-hand side of the pilot's cockpit. To reduce the friction of the slide on the rail (i), bobbin rollers (k) were used.

As shown in Fig. 5, the frame (d) was fixed to the fuselage at four points. When the slide (g) was moving rearwards the tube (e), which had two universal joints (l) and (m), was bent, raising the legs which, due to the oblique position of the axis, came to lie along the axis of the fuselage. To ensure the right position of the bolt in the universal joint (m) at the start of this movement, this joint was provided with the fork (n) resting on the bridge (o).

The apertures in the fuselage skin were closed by double covers, one of which (Fig. 5, detail C) was open all the time when the undercarriage was out and was closed by a spring. The rear flap was opened only when the undercarriage was passing the aperture. Both flaps formed a flush surface with the fuselage skin when the undercarriage was fully retracted.

Differential Gearing

The tail unit (Fig. 6) of cantilever type, consisted of a horizontal plane and ply-covered fin. The fin was built as part of the fuselage. All control surfaces were fabric covered. All control members were kept inside the fuselage. To facilitate the assembly and inspection of the controls, the end of the fuselage, made from welded aluminium sheets (Fig. 6, c), was detachable. The bearings of the control surfaces, similar to those of the ailerons, were fixed at the ends of the elevator and rudder.

Of the bearings, one was arranged to resist axial forces and the other was free to slide. The detail A shows such a typical bearing. Plate (a), with a welded ring retaining the ball bearing, was fixed to the rib. Plate (b), with a welded bolt which was a push-fit into the ball bearing, was fitted to the end of the spar.

Differential transmission was incorporated in the elevator control (detail B), which produced even sensitivity of the elevator at every position of the joy stick. The graph shows the influence of this gearing on the pitching moment, plotted against the angle of the joy stick. The dotted line shows this curve without differential transmission and the plain line with differential transmission. The tail skid was made from three spring plates, after the designers abandoned the idea of a retractable tail-skid.

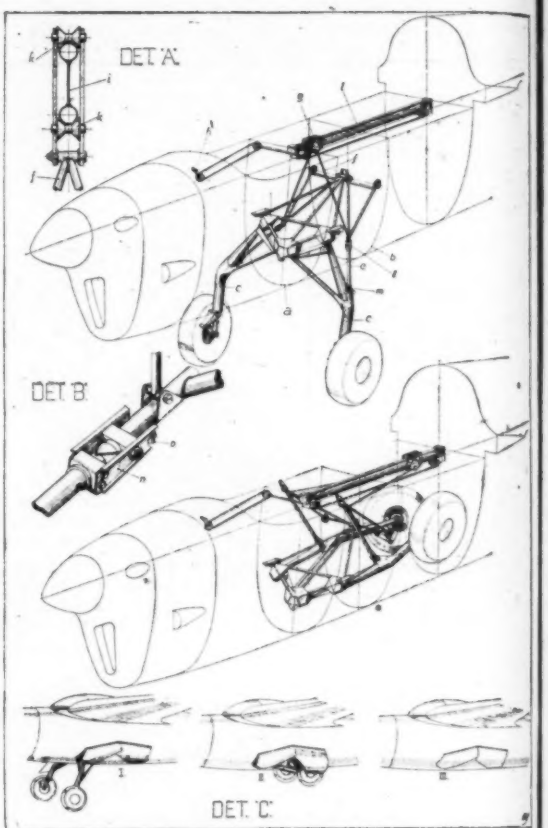


Fig. 5. The undercarriage was retractable and had some unusual features. The author doubts the value of such an undercarriage in a low-power machine

Tests in flight gave the following results:—

Maximum speed	96 m.p.h.
Ceiling	10,500ft.
Stalling speed	45 m.p.h.
Cruising speed	88 m.p.h.
Climb (at ground level)	380 ft./min.

During long hours of tests, the pilots stated that there was complete longitudinal and directional stability. It was found that the differential control of the elevator appeared very useful, making the control soft. All aerobatic manœuvres, with the exception of the roll, were executed. It was found to be very easy to recover from a spin.

The cost of the prototype was £440, of which sum the retractable undercarriage comprised about 30 per cent. When it is considered that without this retracting of the undercarriage the top speed was reduced by only seven miles per hour, and that a smaller reduction would be effected by the use of a streamlined undercarriage fairing, the cost of the retractable undercarriage for a machine of this power may be considered out of all proportion to the benefit obtained. As a matter of fact, the surface finish had far more effect upon the speed! Some tests were carried out with the rough first coat of paint, and the speed obtained was 12 m.p.h. less than with the final highly polished coat. The machine was destroyed by the enemy.

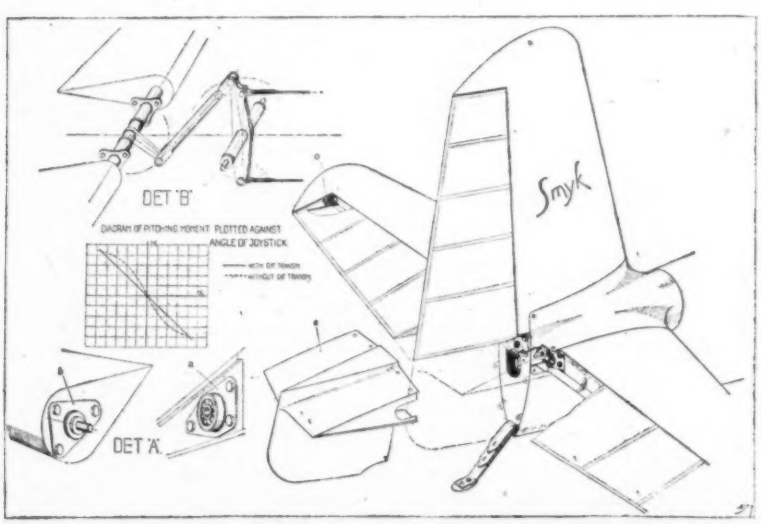


Fig. 6. Details of the tail of the M.I.P. Smyk. The inset curves show effect of the differential control of the elevator.

Topics of the Day

More Work for the Test Pilot

The Case for a Greater Use of Unbiased Flying Opinion and Experience : Balancing Flying and Technical Viewpoints

BY way of a postscript to various remarks, sensible or lighthearted, which I have occasionally made on the subject of test pilots and their work, I should like to make a quite serious suggestion to the Powers that Be in the different R.A.F. Commands. Possibly the scheme is already, in one form or another, being used, but if so, I haven't heard of it. It is one which might effect quite a considerable improvement in squadron efficiency, and might also help to make novice pilots and air crews at least somewhat less worried during the early period of their squadron life.

Briefly, the idea is that every squadron, or at least every Air Force Station, should have its own full-time test pilot and instructor. He could be either Service or civilian in status, so long as he was entirely untouched by rules, regulations and red tape. Since his word would be final, he would preferably need to be a pilot of considerable experience, and, if a serving officer, his rank would need to be high enough to enable him to work on level terms with anybody else but, say, the Station Commander. He would be a picked man, fully capable of being his own master, and would run his little "test flights" as an entirely separate entertainment and would be answerable only to the Stationmaster or his Command headquarters.

The immediate and obvious reaction to such a suggestion will be the cry that there are plenty of experienced pilots on every operational station, and that "surely the squadrons are quite capable of testing their own aircraft." Certainly there are and certainly they are, but the word "independent" is the vitally important one in the case. As an instructor he could pass independent judgment, too, on pilots who appeared to need a rest or a refresher course, as well as giving necessary tips on full-load take-off technique.

The average operational pilot and, for the matter of that, the average leader of operations, is comparatively inexperienced and would welcome the support and help of a pilot, *per se*, who had no axe to grind and who could take any complaints or suggestions to the highest quarters. Furthermore, the average ops. pilot is much more interested in the business of getting on with the war than in seeing that his aircraft is absolutely perfect.

Apparently Trivial Warnings

Whereas the squadron pilot, for various obvious reasons, would not care to snag a machine on apparently trivial grounds, the permanent test pilot would have no hesitation in so doing. The words, "my port engine is running quite well, but it is making rather a funny noise and is rough," are not likely to impress an engineer officer when they come from the lips of someone who has done, perhaps, only a couple of hundred hours; the two-thousand hour chap could voice the doubt in an entirely more convincing way and might even produce rather more factual evidence after an hour or so in the air.

At least, with the test pilot, there would be no question of "cockpit trouble," and the matter would need to be looked into. At the best, the squadron pilot would afterwards feel happier, and at the worst he might be saved the job of bringing back his machine on one engine from the middle of Europe. We all know of cases where nothing more than a "funny noise" has been the prelude to the most monumental failure, with gold dust in the filters and all the etceteras. The present-day aircraft engine and airframe rarely gives up without lots of warning, but the warnings are often very trivial to the mind, hands and ears of the not-so-experienced pilot.

The average engineer officer is a hard-working and honest man whose sole interest is in the business of keeping as many good aircraft in the air as possible. But there are exceptions. Sometimes these exceptions are ignorant and unimaginative, sometimes they are just so hard-worked that they cannot keep up and are liable to hope for the best rather than to know that all is well. The first lot talk about "cockpit trouble," or laugh aside petty complaints because they haven't the imagination to know what it feels like to sit for hours in the dark over an enemy country listening to a "funny sound."

Perhaps, to quote a very simple and common possibility, the squadron pilot comes down from a test flight with the report that the port oil temperature is twenty-five degrees higher than normal. The ignorant E.O. might reach out for his engine manual and point out the printed limitations with a faint sneer. No power on earth will make that kind of person see the difference between a limitation figure and a normal figure. The first is the sort of thing you make your engine put up with when there is no alternative and you've got to get home; the second is the figure on which you base all your judgments of an engine's health.

Normal and Limitation Figures

Quite obviously, there is something very wrong with an engine in which the oil temperature, at normal boosts and on a cool day, is 85 deg. instead of 60 deg. If the gauge itself isn't at fault, then there's trouble brewing. If the limitation figure is, say, 90 deg., then there is only a five-degree margin between the figure obtained on a normal flight and one of the "five-minutes only" kind. What does the engineer officer think the figure will be on a long climb at maximum rated boost, flying with full load at a comparatively low air speed? It *might* stay at 85 deg. but the chances are that the motor would be disintegrating before the machine had reached the English coast.

That is the sort of thing that will be jumped on by my unbiased test pilot—that and queerities like minor aileron flap and unaccountable tail-heaviness, which would be a thundering nuisance, to say the least of it, on a long flight. They will be jumped on, too, by the engineer officer when he is quite, quite certain that he is dealing with a pilot who knows what he is talking about and one who, additionally, has no possible reasons for imagining trouble.

Although, as I've said, the Station test pilot *should* be an all-round man with plenty of experience, these qualifications are not entirely necessary if there is a shortage of such men. In the case of a squadron job he could even be a one-type pilot with a few hundred hours to his credit. But the last fifty or so of those hours should have been obtained with the factory producing the type, or with a maintenance unit handling an appreciable number. At the works he could have learnt all about the various snags which are likely to be met, and would also have developed a very good idea of a "normal" machine of the type in question. After a reasonable length of time at the works he could be almost as much of an engineer as the E.O. himself and be able to tackle him on his own ground (much to his annoyance and admiration).

But it would be no earthly good giving the job to a "resting" pilot officer or sergeant pilot unless he is taken right away from his previous station and given an acting rank which would enable him to get things done. The whole idea is useless if the test pilot is not independent, and big enough to make his independence felt.

Everything is going on very well without the interference of any confounded test pilots? Well, it was fun writing about it and thinking what an interesting job it could be for someone. My test pilot would even visit the works before a squadron starts in on a new type and would bring back all the gen. and a host of new, apocryphal and libellous stories about the production of aircraft, M.A.P. and the chaps at the Air Ministry.

INDICATOR.

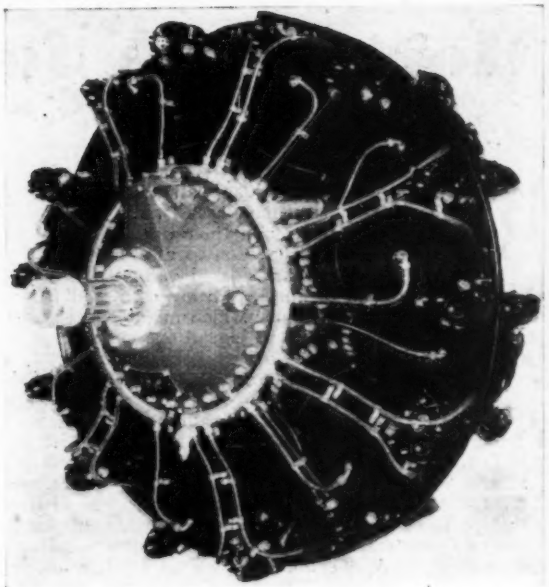
Wright Double-row Cyclone

An American 14-cyl. 1,600 h.p. Radial of 2,603 cu. in. Capacity : Single-speed or Two-speed Blowers

AS early as 1930 the engineers of the Curtiss-Wright Corporation of America had developed a double-row radial engine of moderate displacement on which wide experience was gained through extensive tests and flight operations. Subsequent modifications increased its output to approximately 900 h.p., and a basic design was established which eliminated many of the disadvantages previously associated with double-row engines. This engine, however, fell in the same power class as the single-row Cyclone of that time, and development was held in abeyance until such time as a really great increase in power should be needed.

The year 1938 saw the introduction, on a production scale, of an aircraft engine 30 per cent. more powerful than any then available. This engine was the Wright double-row Cyclone 14, of 1,500 h.p., which made possible the design of the Pan American Airways 41-ton Boeing Clippers. These, with the British Short Bristol-engined commercial flying boats, paved the way for the trans-atlantic operations. Although put to immediate commercial use, the double-row Cyclone 14 remained under U.S. Government restriction and was adopted by the U.S. Navy for its Martin patrol boats and by the U.S. Army for various types of attack and bomber aircraft. Due to these restrictions little became known of the engine except that it was obviously a development of the single-row Cyclone. The engine was remarkably successful from its inception, having passed all its tests in a very short time and emerging as a production engine with practically no change from the original design. It was conservatively rated at 1,500 h.p., which was later increased to 1,600 h.p. for take-off, with 1,350 h.p. available for normal operation.

Many parts of the double-row Cyclone 14 are similar to those of the single-row Cyclone. With the exception of the crankshaft and the crankcase, the basic design remains unchanged from that of the engines on which over 500,000,000 operating miles of experience have been gained. Refinements have, however, been incorporated. The cylinders, for example, though similar in appearance to previous Cyclone types, have much greater cooling area.



The cylinders of the Double-row Cyclone are similar to those of the single-row engine, but have larger cooling area.

The engine is a staggered radial of 14 cylinders, having a total displacement of 2,603 cu. in. Cylinder bore is the standard 6.125in. of the single-row Cyclone, but the stroke is slightly shorter, being 6.312in. instead of 6.875in. The diameter of 55in. is the same as that of previous Cyclones, but so compact is the construction that the additional row of cylinders has been accommodated in little more than a foot extra in length, which includes an extension of the accessory section to provide a more streamlined passage for the mixture between carburettor and supercharger.

Cylinders follow usual Cyclone construction of cast aluminium alloy heads shrunk on forged nitralloy steel barrels. Head finning is deeper than usual, and intake and exhaust ports are at the rear on all cylinders. Valves are inclined to the centre line of the cylinder at an angle which enables a hemispherical combustion chamber to be used. Valve guides, seats, intake pipe and push rod housing connections are shrunk into the head.

Sparking Plug Cooling

Two bronze sparking plug bushings, just above the main horizontal cooling fins of the head, are located at 90 deg. of each other and surrounded by deep vertical cooling fins arranged to permit a free flow of air over the finned sparking plug. The inside of the forged steel cylinder barrel is nitrided to the hardness of glass and given a micro-finish that leaves no point of roughness greater than two millionths of an inch. Cooling fins are machined on the outside for heat dissipation, and improved attachment of the head is provided by ground threads.

The main section of the crankcase consists of three aluminium forgings, divided along planes through the centre of the cylinder locations. They are bolted together between the cylinders of each bank. These combined main sections contain the three main crankshaft roller bearings and support the front and rear cam drive gear assemblies, the cams, and the tappet and guide assemblies. The nose section provides for vertical mounting of a constant-speed airscrew governor and is machined from an aluminium

CYCLONE 14 C14A and C14BA

Engine Model	Dry Wt. lb.	Blower Ratio	Take-off r.p.m.	Take-off h.p.	Sea Level r.p.m.	Sea Level h.p.	Low Blower r.p.m.	Low Blower h.p.	Low Blower ft.	High Blower r.p.m.	High Blower h.p.	High Blower ft.
579C14AC1 (-A2A)	1,935	7.00 : 1	2400	1600	2300	1350	2300	1350	6200	—	—	—
GR2600-A2B ...	1,935	7.00 : 1	2400	1600	2300	1350	2300	1350	5800	—	—	—
GR2600-A5A ...	1,950	7.14 : 1 and 10 : 1	2400	1600	2300	1350	2300	1350	5000	2300	1275	12000
GR2600-A5B ...	1,950	7.14 : 1 and 10 : 1	2400	1600	2300	1350	2300	1350	5000	2300	1275	11500
585C14BA ...	1,965	7.30 : 1	2500	1700	2400	1500	2400	1500	6700	—	—	—
586C14BA ...	1,980	7.06 : 1 and 10.02 : 1	2500	1700	2400	1500	2400	1500	6700	2400	1350	15000

The first four models have an airscrew reduction gear ratio of 0.5625. The 585C14BA model has a ratio of 0.4375, and the last model in the table may have 0.5625 or 0.4375.

The C14A model has a diameter of 55in. and a length of 62.06 in. The corresponding figures for the C14B are 54.25 in. and 63.40in. respectively. Both models have a bore of 6.125in. and a stroke of 6.312in.

WRIGHT DOUBLE-ROW CYCLONE

alloy casting. This section holds the thrust bearing and houses the airscrew speed reduction gears, which give either 16 : 9 or 3 : 2 reduction ratios.

To provide outlets for the 14 pipes to the cylinder intake ports the supercharger front housing has been enlarged. In addition to acting as the front wall of the diffuser chamber, this section is provided with seven mounting bosses designed for use with rubber mounting blocks or the Wright Dynamic Suspension mounting.

The accessory drive section forms a mounting for the diffuser plate, holds the impellor and impellor drive shafts, and houses the self-turning Cuno oil filter, two gun synchroniser drives, fuel pump and two tachometer drives. The down-draught carburettor is mounted on this section, which also forms the induction passages to the impellor.

The rear cover plate for mounting of the other accessories is a magnesium alloy casting similar in most respects to that used for the single-row Cyclone. On this plate are pads for the two magnetos, generator, starter, oil pump and spare accessory drive. It also forms the support for the shafts and gears of these drives.

To realise the inherent advantages of single-piece master connecting rods, the crankshaft is designed in three pieces to permit the use of such rods. The three pieces are clamped together with the centre section, consisting of the two crankpins at 180 deg. from each other, with a journal for the centre main roller bearings. The entire shaft is hollow throughout to provide passage for the central oil supply, each crankpin being drilled for two oil outlets to the bearing. This makes an oil cleaning centrifuge of the crankpin chamber. A flat machined on each crankpin carries the oil out along the bearing surface. The rear of the crankshaft has an internally splined extension for insertion of the accessory drive and starter shaft. Counterweights of the crankshaft incorporate the Wright Dynamic Damper, eliminating the effects of torsional vibration on the engine and airscrew.

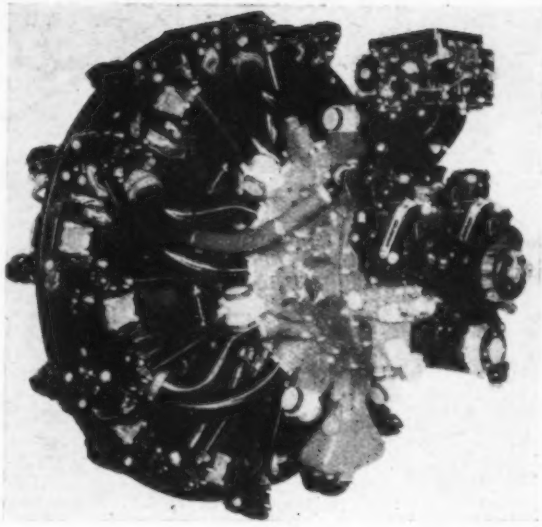
Reduction Gearing

The 50-spline (S.A.E.) airscrew shaft is machined from an alloy steel forging and is hollow throughout its length. It is supported by two steel-backed copper-lead bushings running on the front of the crankshaft, on which is mounted the thrust bearing. The rear of the shaft is forged into a six-legged spider, each leg supporting one of the pinions used in the airscrew speed reduction system. The shaft is drilled to provide lubrication channels to these pinion bearings. The planetary reduction gear is essentially the same as used on previous Cyclones.

Machined from alloy steel forgings, the one-piece master rods differ in appearance from single-row rods mainly in that each accommodates only six articulated rods instead of eight. The shank is an H section, the flanges of which are a continuation of the flanges at the channel at the crankpin end. The steel-backed copper-lead crankpin bearings are a shrink fit into the bore of the master rod. The shells are dowelled into place, with six oil holes in each bearing supplying oil from this bearing out through the rod to the knuckle pins. The articulated rods are I sections, also machined from alloy steel forgings. The split bronze knuckle and piston pin bushings are pressed into the rods and the ends spun over.

Knuckle pins are nitralloy steel, with their nitrided surfaces given a micro-finish. The pins are a press fit into the master rod, and are secured by a flange at one end and locking plates at the other.

The pistons are full trunk type aluminium alloy forgings, the heads strengthened and cooled internally by ribbing. Five ring grooves are used, four above the gudgeon pin and one in the skirt. A single compression ring fits in each of the three grooves nearest the top of the piston, with two vented oil control rings in the fourth groove and an oil scraper ring in the bottom groove. The oil ring grooves are drilled to permit drainage into the piston interior.



The Wright Cyclone Model C14A. The large carburettor is a non-icing Chandler-Groves, and ignition is by two Scintilla magnetos.

Two valve-operating cams are fitted, each of which is supported on journals mounted on the front and rear of the main crankcase. Each cam is an alloy steel forging having two sets of cam lobes which are given a micro-finish. The cams are driven through intermediate gears from two gears, one integral with the airscrew reduction drive gear, and the other attached to the rear end of the crankshaft. Both cams rotate at one-sixth crankshaft speed in a counter-crankshaft direction. The cams actuate the valves by a push-rod and rocker-arm system, which incorporates drilled pasages to provide fully internal automatic valve gear lubrication. A solid intake valve and a hollow exhaust valve partially filled with sodium follow the usual Cyclone practice.

A single supercharger impellor is used, driven by intermediate gears from the accessory drive shaft. The conventional intermediate gears may be replaced by the Wright two-speed supercharger drive, giving the same sea-level performances and greatly increased power output at high altitudes. The supercharger drive ratio is 7.00 : 1, 7.40 : 1, or 7.14 : 1 and 10.00 : 1, depending on the model. Curved intake pipes lead out radially from the diffuser chamber to the cylinders.

Lubrication System

The lubrication system is of the full-pressure type to all surfaces except the cylinder walls and piston pins. These are lubricated by oil sprayed from the main crankpin bearings. A single housing on the rear of the engine contains both the pressure and scavenge pumps. All engine oil drains to a sump at the bottom of the engine, directly behind the lower front cylinder, whence it is removed by the scavenge pump and returned to the external oil supply.

Non-icing carburation is provided by a large Chandler-Groves type carburettor, similar in design to those used on the G-100 Series Cyclones. Ignition is supplied by two Scintilla magnetos through Breeze shielded ignition cables. Drives for all accessories and flight instruments are virtually identical with those of previous Cyclones.

It may be seen from the above description that the double-row Cyclone 14 cannot be considered a new engine except when taken as a whole. Behind its component parts is the experience of the single-row Cyclone, a background which explains its immediate acceptance. Recent orders by the U.S. Army Air Corps have brought the engine to the forefront as a dominant American military type, a position long held by its single-row predecessor.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

BLOWING THE TRUMPET
Well-balanced Force of All Arms

AN article in the editorial columns of *Flight* of January 28th sharply criticises Sir Arthur Tedder for his declaration, "Air supremacy will win the war," and goes on to give reasons for describing it as both exaggerated and ill-considered.

While it is, of course, essential to keep a sense of proportion and to avoid over-sweeping conclusions, many people will accept these words of Sir Arthur's as no more than the statement of a fundamental truth; surely it is by the exercise of overwhelming air supremacy, in the strategic sense, that we shall secure for ourselves—and deny to the enemy—that well-balanced force of all arms that the editorial article rightly lays down as essential for victory.

Little has been said of the part played by Bomber Command's offensive against German industry in making possible the great offensives in Egypt and Southern Russia. Yet if Hitler had been able to pack just a little more punch into *his* 1942 offensives, Alexandria and Stalingrad might well have fallen, and then the whole course of the war would have taken a vastly different turn.

It would be a great injustice to the men of Bomber Command if we failed to recognise the part their efforts have played in these offensives, and will do in those of the future.

It would be interesting to know what other readers think.

D. M. S.

"UNSUNG WORTHIES"
No Thrills for O.T.U. "Flight Mechs."

MAY I express my appreciation of your few words of recognition of the work done by R.A.F. ground crews. We all admire our air crews; no words of praise are too good, and undoubtedly the glory they have won will last for ever. But, both inside and outside of the Service, few people realise the nature or value of the work carried out by the crews, particularly the "flight mechs." Not all of these chaps are young and keen; not all of them serve in the operational squadrons with the stimulus of several victories to spur them on. Few indeed are the words of praise they receive, and still fewer medals, "unadorned," as you say, and almost unheard of, but how many people know anything about the work done by our flight mechs. on, say, an O.T.U.?

As you probably know, the one thing that matters in one of these units is the number of hours flying per month. Now the newspapers, and certain picture periodicals, always seem to convey a certain glamour to their pictures. They don't show the desolation of a gale-swept, rain-sodden satellite 'drome; they don't show the chaps installing a new engine or fitting a rad. or oil cooler in *old* Hurricanes in the grease and mud in which they work. (We haven't all got hangars, and shelter tents are not always practicable.) They don't express the thoughts of the chaps who, having lain in the mud and grease all day, changing said rad. and cooler, watch the aircraft "prang" on the edge of the field because a "Gremlin" moved the airscrew control into coarse pitch (incidentally, the men's opinion of the "Gremlin" rubbish is very vivid at these moments). They usually tell the "Gremlin" concerned what they think of him and his flying capabilities.

Again, the newspapers and periodicals do not show impatient flying instructors worrying an already much harassed flight sergeant for more and still more serviceability, whilst said flight sergeant is desperately trying to adjust ration strengths, nominal rolls, leave rolls, pay forms, guard rotas, personnel movements and personal problems of the chaps, to say nothing about the dozens of technical returns demanded, checking stores, checking F.200s for fuel and oil consumptions and signatures for filling of aircraft, etc., etc. Then there is the other side of it—trying to arrange entertainment for the blokes (no ENSA concerts here), the 'phones ringing all the while ("can you send me a man for coal fatigue?" and "why haven't the A.C.P. and D.P. been relieved for meals?" and "can you find Sgt. Plt. So-and-so's cycle? He left it lying under the fuel house."

All the while, in the same office, the instructors are doing wizard "slow rolls," etc. (on the flight table), at the same time lighting their cigarettes with the handiest spill available; it's only the return of yesterday's flying times for the Wing Commander! And usually at this quiet time in comes a body to tell me that the gear-lever on the tractor has sheared and what can we do about it as the kites have to be refuelled.

But, somehow, we struggle through. We usually get in all the necessary he has demanded; if we get too many then there's a strawberry from the W.Cdr. (flying), and always a raspberry from the W.Cdr. (maintenance).

So if you are walking down the road past the station one wet, cold and windy evening just before dark and you see a tired-looking dirty airman making his way from the dispersal to the dining hall, don't always assume he is going to have a nice hot shower, followed by a lovely hot tea, and then a concert. He has probably got to be back at the dispersal in an hour's time for guard duty all night—to be "chewed up and torn off a strip" by the N.C.O. i/c. flight next morning for being late and not signing up for his D.I., or losing a torch. Whilst for his part he is probably wondering when, if ever, he is going to hear anything more about the pilot's course he is trying to get, or the reclassification board to A/C.1 or L.A/C.; and if he has definitely stopped the oil leak in the engine he has slaved on for the past day or so—"Unadorned," Sir, yes, and indispensable!

AN ADMIRER OF THE GROUND CREWS.

UNNECESSARY SECRECY
No Data Given in Enemy Press

MAY Mr. Henderson be asked why he makes the statement that "almost every country that matters, including Germany, knows all about our new aircraft, sometimes before we do ourselves."

Is it not precisely because, time and again, the hands of those in authority are forced to do just what Mr. Henderson suggests that this deplorable state of affairs may exist? How else do our enemies know of our new aircraft except through this untoward publishing of details in one section or other of the British Press?

Does the mass of our would-be experts appreciate the possible damage so caused, the almost unbelievable assistance so given our enemies, apart altogether from any possible cost in the lives of our Fighting Services?

Will Mr. Henderson and his ilk produce any worth-while photo, much less technical data, obtained from the enemy Press even prior to the war, much less now? Has Mr. Henderson ever seen one single diagram, in any enemy publication, of any current type such as we habitually broadcast of our magnificent designs?

From an enemy point of view, all must be complete gifts, and may it be pointed out that those who operate our new service types are surely fully conversant with them. Those who do not, need no knowledge until production is such that essential defence services should be advised. But even that does not mean us, the public; it means *essential* services; the rest of us should be content, in time of war, to be told that we have, for example, "a magnificent bomber, capable of carrying a heavier load than any other existing bomber, and over a longer range at a greater speed."

Long after, when it is quite certain that no information of *any use whatsoever* can be given our enemies, photographs might be published. Even so, one would imagine that such photographs should be carefully doctored, or, contrary to Mr. Henderson's fond theory that "photographs do not assist very much," they might be of utmost assistance.

"PRO PATRIA."

[Readers who condemn the publication in the technical Press of drawings and photographs of British military aircraft appear to overlook the fact, or are unaware of it, that Government regulations concerning publication are such that no detailed illustrations may appear until there is ample evidence that so many examples of the particular type of aircraft have fallen into enemy hands that no useful purpose would be served by withholding from our own people information which the enemy is known to possess.

The fact that foreign journals, and in particular enemy journals, do not contain detail sketches such as those which British technical journals are in the habit of publishing is beside the point. That is a national characteristic which operated long before the war. For some reason, foreign technical journals, with the exception of American and one French monthly (*l'Aeronautique*), do not employ technical artists. The fact has nothing to do with security reasons, and, in fact, foreign editors have frequently expressed to us their envy and the wish that they could find artists to do the sort of drawings for which British technical journals are famous.—ED.]

Service Aviation

Supermarine Seafires lined up at a Fleet Air Arm shore base.

Royal Air Force and Fleet Air Arm News and Announcements

High-Command Changes

Air Chief Marshal Sir Arthur Tedder, Vice-Chief of the Air Staff, and until recently A.O.C.-in-C., R.A.F., Middle East, has arrived in England to take up his new appointment. He was received in audience by the King, who invested him with the G.C.B.

On his way from Cairo Sir Arthur took part in the conferences at Casablanca.

His place in Egypt was taken by Air Chief Marshal Sir Sholto Douglas, whose post of A.O.C.-in-C., Fighter Command is now held by Air Marshal Sir Trafford Leigh-Mallory.

Air Vice-Marshal J. Slessor has taken over as A.O.C.-in-C, Coastal Command, with the acting rank of air marshal. He succeeds Air Chief Marshal Sir Philip Joubert de la Ferte, who becomes an inspector-general of the R.A.F.

Awards

Fleet Air Arm

THE KING has been graciously pleased to approve the following awards: For courage and skill in a successful attack on an enemy submarine.

DISTINGUISHED SERVICE CROSS.

Temp. Sub. Lt. (A) T. H. HANDS, R.N.V.R.
Temp. Act. Sub. Lt. (A) W. O. FINDLAY, R.N.V.R.

DISTINGUISHED SERVICE MEDAL.

Act. Ldg. Airman E. F. HARTWELL.

For bravery and resolution in H.M. ships, while taking a convoy to North Russia in the face of relentless attacks by enemy aircraft and submarines:—

MENTION IN DESPATCHES.

Temp. Sub. Lt. (A) R. WIGNALL, R.N.V.R.

Royal Air Force

Award of Foreign Decorations

THE KING has granted unrestricted permission to the wearing of the undermentioned decorations, conferred on the personnel indicated, in recognition of valuable services rendered in connection with the war:—

Conferred by the King of the Hellenes

ROYAL ORDER OF GEORGE I (WITH SWORDS)

(COMMANDER)

Air Vice-Marshal R. A. GEORGE, M.C.
Air Comdre. L. O. BROWN, C.B.E., D.S.C., A.F.C.
Act. Air Comdre. A. S. G. LEE, M.C.

(OFFICER)

Act. Air Comdre. G. R. BEAMISH, C.B.E.
Grp. Capt. W. H. MERTON, O.B.E.
Grp. Capt. W. A. B. SAVILE.
Grp. Capt. A. H. WILLETTE, D.S.O.

Wing Cdr. G. L. Raphael, R.A.F.O., No. 85 Squadron, who has been awarded the D.S.O. in addition to a Bar to his D.F.C. The official citation appears on page 160.

ROYAL ORDER OF THE PHŒNIX

(GRAND OFFICER)

Air Vice-Marshal J. H. D'ALBIAC, C.B., D.S.O.
Air Comdre. H. G. SMART, C.B.E., D.F.C., A.F.C.

GREEK DISTINGUISHED FLYING CROSS

Wing Cdr. J. R. GORDON-FINLAYSON, D.S.O., D.F.C.
Wing Cdr. E. G. JONES, D.S.O., D.F.C.
Wing Cdr. D. G. LEWIS, D.F.C.
Wing Cdr. P. STEVENS, D.F.C.
Wing Cdr. J. R. WILSON, D.F.C.
Act. Wing Cdr. L. G. BURNAND, R.A.F.O.
Act. Wing Cdr. R. H. SPENCER, R.A.F.V.R.
Sqn. Ldr. E. H. DEAN.
Sqn. Ldr. E. A. HOWELL, O.B.E., D.F.C.
Sqn. Ldr. E. A. W. R. HUGHES, O.B.E.
Sqn. Ldr. G. V. W. KETTLEWELL.
Sqn. Ldr. R. A. MILWARD, D.F.C.
Sqn. Ldr. L. G. SCHWAB, D.F.C.
Act. Sqn. Ldr. K. C. V. D. DUNDAS, D.F.C. (since missing).
Act. Sqn. Ldr. A. K. PASSMORE, D.F.C.
Flt. Lt. C. H. FRY, D.F.C.
Flt. Lt. S. H. GASKELL, R.A.F.V.R.
Flt. Lt. A. C. GODFREY, D.F.C.
Flt. Lt. R. W. HARRISON.
Flt. Lt. H. W. LAMOND.
Act. Flt. Lt. B. ASHMOLE, R.A.F.V.R.

GREEK AIR FORCE CROSS

Grp. Capt. E. C. LEWIS.
Wing Cdr. W. BADLEY.
Wing Cdr. J. H. CHAPLIN, D.S.O., D.F.C.
Wing Cdr. P. G. CHICHESTER.
Wing Cdr. G. W. P. DAVIDSON, R.A.F.V.R.
Wing Cdr. R. W. L. GLENN.
Wing Cdr. H. R. GOODMAN.
Wing Cdr. H. F. LEVELL.
Wing Cdr. C. W. M. LING.
Wing Cdr. L. ROSE.
Act. Wing Cdr. A. A. D. SEVASTOPULO, R.A.F.V.R.
Act. Wing Cdr. J. F. H. HARGRAVE, R.A.F.V.R.
Sqn. Ldr. F. P. DAWSON.
Sqn. Ldr. D. J. STEWART, R.A.F.O.
Flt. Lt. D. S. JENKS, R.A.F.V.R.
Flt. Lt. R. PENGELLY.
Flt. Lt. B. J. LYNCH, R.A.F.V.R.
F/O. H. BLACK, R.A.F.V.R.
P/O. J. W. G. READER, R.A.F.V.R.
W/O G. E. BAILEY, D.F.M.
W/O. P. J. SOPER.

Conferred by the Belgian Government

MILITARY CROSS, FIRST CLASS

Wing Cdr. J. M. THOMPSON, D.F.C., R.A.F.O.

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

DISTINGUISHED SERVICE ORDER

Wing Cdr. G. L. RAPHAEL, D.F.C., R.A.F.O., No. 85 Sqn.—Since being awarded a Bar to the D.F.C., Wing Cdr. Raphael has destroyed three enemy aircraft at night. By his inspiring leadership, great skill and untiring efforts, he has contributed in a large measure to the high morale and operational efficiency of the squadron he commands.

DISTINGUISHED FLYING CROSS.

Act. Flt. Lt. C. B. J. PORTER, R.A.F.V.R., No. 51 Sqn.—This officer is employed as squadron bombing leader or navigator. He participated in many sorties with great success, including the operations against Cologne and the Ruhr on May 30th last and June 1st, 1942.

Act. Flt. Lt. C. F. ROSE, D.F.M., No. 521 Sqn.—Since April, 1942, this officer has participated in many operational sorties. As a pilot he has shown the greatest courage, determination and devotion to duty at all times. He has taken part in many daylight sorties deep into enemy territory, the large majority of which have been of an exceptionally hazardous nature.

Act. Flt. Lt. T. R. RUSSELL, R.A.F.V.R., No. 138 Sqn.—This officer has participated in a number of operations. He has proved his worth as an able and determined captain, and has displayed great resource and judgment.

Act. Flt. Lt. W. C. SANDERSON, R.C.A.F., No. 408 (R.C.A.F.) Sqn.—Flt. Lt. Sanderson has participated in attacks on many important enemy targets, including Emden, Bremen, Hamburg, Saarbrucken and Dusseldorf. He is a determined pilot whose skill in pressing home his attacks in the face of heavy opposition has been outstanding.

Act. Flt. Lt. E. H. G. STRINGER, R.A.F.V.R., No. 50 Sqn.—As navigator, this officer has participated in attacks on many of the more important targets in Germany. He is now serving as squadron navigation officer and his skilful efforts have done much to improve the standard of operational navigation.

Act. Flt. Lt. F. D. J. THOMPSON, R.A.F.V.R., No. 7 Sqn.—Flt. Lt. Thompson in the role of navigator has completed a large number of operational sorties, including many on the most difficult targets, in Germany and Italy. The consistent skill displayed by this officer and his determination to press on, however unfavourable the conditions, have, to a large extent, accounted for the success of the missions upon which he has been engaged.

Act. Flt. Lt. W. B. VAUGHAN-DAVIES, R.A.F.V.R., No. 102 Sqn.—This officer is a skilful and experienced air gunner. He has displayed outstanding devotion to duty and, regardless of the five aircraft crashes in which he has been involved (on one occasion he had to swim a considerable distance to reach land), his keenness has remained undiminished. Flt. Lt. Vaughan-Davies has participated in attacks on most of the enemy's heavily defended targets.

SERVICE AVIATION

Act. Flt. Lt. W. N. WHAMOND, R.A.F.V.R., No. 106 Sqn.—This officer has taken part in many attacks on the enemy's most heavily defended areas, including the Ruhr Valley, Hamburg, Bremen, Rostock, and in the "thousand-bomber raid" on Cologne. On one occasion he made a very determined attack on Gdynia and a few weeks later bombed a factory in Northern Germany from less than a thousand feet, in the face of intense anti-aircraft fire.

F/O. A. J. CARRINGTON, R.A.F.V.R., No. 200 Sqn.—This officer has completed a large number of operational sorties many of which have been accomplished over hostile territory in the face of anti-aircraft fire and fighter defences. He has secured excellent photographs, thereby providing valuable and essential information. F/O. Carrington has also displayed outstanding ability and devotion in connection with convoy escort duties, shipping reconnaissance, and anti-submarine operations.

F/O. T. B. COLE, R.A.F.V.R., No. 50 Sqn.—On the night of August 27th, 1942, F/O. Cole was captain of an aircraft detailed to attack Kassel. After successfully bombing the target, he made a most effective low-level attack on a train. He also participated in the daylight raid on Le Creusot, in an attack on Genoa, and in all of the three "1,000-bomber raids" on Western Germany. In the course of many operational sorties this officer has achieved many successes by descending to a height from which the bomb aimer could clearly identify the target.

Le Creusot and Milan

F/O. A. H. CROWE, No. 106 Sqn.—In addition to many operations against industrial areas in enemy territory, F/O. Crowe has participated frequently in mine-laying operations with much success. During the daylight attack on Le Creusot he kept formation with his squadron commander in spite of most adverse weather. He also took part in the attack on Milan, where he bombed the target from a height of 6,000 feet.

F/O. H. G. FROW, R.A.F.V.R., No. 61 Sqn.—This officer has an outstanding record as an operational pilot. On one occasion he was captain of an aircraft which was engaged in mine-laying operations in daylight at sea. Despite intense anti-aircraft fire, by which his aircraft was damaged, he accomplished his mission successfully.

F/O. L. H. GLASSPOOL, R.A.F.V.R., No. 12 Sqn.—F/O. Glasspool has proved himself to be an exceptionally able navigator. He has taken part in many sorties, including attacks on the Gnome Rhone Works, Warnemunde and Dusseldorf, from comparatively low heights.

F/O. J. G. GRANT, R.A.F.V.R., No. 502 Sqn.—One day in November, 1942, this officer was captain of an aircraft on patrol in the Bay of Biscay when he sighted a U-boat fully surfaced. Notwithstanding the accurate machine gun fire from the enemy U-boat, F/O. Grant persisted in his attack with great determination, and dropped his depth charges from a low altitude.

F/O. C. D. KEIR, R.A.F.V.R., No. 97 Sqn.—F/O. Keir has participated in many attacks on enemy targets, including the daylight raid on Le Creusot. In May, 1942, he participated in an attack on the engine works at Gennevilliers. The aircraft received severe damage by anti-aircraft fire and the second pilot was killed. In the face of great difficulties F/O. Keir successfully flew his aircraft back to this country.

F/O. D. H. S. LONSDALE, R.A.F.V.R., No 9 Sqn.—F/O. Lonsdale has taken part in many operational sorties, including the recent daylight raids on Le Creusot and Milan. As a captain of aircraft he takes meticulous care in the preparation of his sorties and performs them with vigour and determination. On several occasions he has spent long periods over heavily defended areas until able to identify his target clearly and bomb it from a low altitude. During the daylight attack on Milan he went below cloud to bomb. After leaving the target he found four of his bombs had not released and, although encountering intense anti-aircraft fire, he made a second run over the target and released the bombs successfully.

DISTINGUISHED FLYING MEDAL.

Sgt. G. H. GITTINS, No. 150 Sqn.—As air gunner, Sgt. Gittens has taken part in many successful operational sorties on some of the enemy's most heavily defended areas, including Essen, Hamburg and Bremen. One night he was detailed to attack Osnabruck. Soon after crossing the enemy coast his aircraft was attacked by a Ju 88 and severely damaged. Sgt. Gittins waited until the enemy came within very close range and then opened fire, causing it to go down in a spiral dive. Sgt. Gittins then drove off a second enemy fighter which was preparing to attack. On at least two other occasions this airman's aircraft has been damaged by enemy fighters, which have been driven off.

Sgt. R. W. R. GRELLIER, No. 57 Sqn.—Sgt. Grellier, as air-gunner, has participated in many operational sorities, including recent raids on Le Creusot, Genoa and Milan. One night in June, 1942, he was a member of a crew detailed for operations against Bremen. On the return flight his aircraft was fiercely attacked by anti-aircraft guns and took fire. Eventually it was necessary to bring the aircraft down in the sea, and three members of the crew, including Sgt. Grellier, were in a dinghy for 37 hours before being rescued.

Sgt. D. A. HARCOURT, No. 158 Sqn.—Sgt. Harcourt is a wireless operator of outstanding merit. He has participated in many successful attacks, which have included targets at Rostock, Hamburg, Dusseldorf, and many others.

Sgt. D. KINGSTONE, No. 207 Sqn. (since reported missing).—Sgt. Kingstone was the wireless operator of an aircraft which failed to return from a sortie on September 8th, 1941. The crew were forced to leave the aircraft by parachute, and it was largely owing to the calmness displayed by this N.C.O. that this was performed successfully.

Sgt. I. L. E. MANTELL, No. 142 Sqn.—This wireless operator has successfully completed numerous operational sorties over enemy and enemy-

Some of the pilots and crews of the Mosquitoes which bombed Berlin in daylight, left to right: F/O. R. G. Hayes; F/O. R. C. Morris; Flt. Sgt. F. J. D. McGeehan; Sgt. J. Massey; F/O. J. T. Wickham; Flt. Lt. J. Gordon; Sqn. Ldr. R. W. Reynolds, D.F.C.; Sgt. R. C. Fletcher; P/O. E. B. Sismore; P/O. W. E. D. Makin.

occupied territory. One night in July, 1942, Sgt. Mantell's aircraft was attacked by a Ju 88. After a fierce engagement the hostile aircraft was destroyed. This airman's skilful directions to his pilot were largely responsible for the successful conclusion of the encounter.

Sgt. F. E. MITCHELL, R.C.A.F., No. 15 Sqn.—Sgt. Mitchell is employed as a wireless operator. He has completed numerous sorties, including attacks on such heavily defended targets as Emden, Bremen, Duisburg, Frankfurt, Kiel and Cologne.

Sgt. G. V. MOINET, No. 233 Sqn.—This airman has completed a large number of sorties and anti-submarine patrols, and has displayed great skill and efficiency as wireless operator/air gunner. On a recent occasion he participated in a very successful attack on a U-boat, in the Western Mediterranean, in the face of intense enemy fire. One engine of the aircraft was badly damaged, but Sgt. Moinet continued his tasks with great coolness and courage.

Sgt. A. NORMAN, R.C.A.F., No. 408 Sqn.—Sgt. Norman has shown exceptional skill and gallantry as a wireless/ operator/air-gunner. One night in August, 1942, he was a member of a crew detailed to attack Duisberg. The aircraft was attacked by an enemy fighter while over the target area, and Sgt. Norman was wounded in the scalp, face and right hand. The aircraft was extensively damaged, but he courageously remained at his post without complaining.

Sgt. D. C. NOWELL, No. 78 Sqn.—Sgt. Nowell has taken part in a number of operational sorties, the majority of which have been on the most heavily defended German targets, and has always displayed calm efficiency in adverse and hazardous circumstances.

Operated Turret by Hand

Sgt. E. G. POWELL, No. 15 Sqn.—As a rear gunner Sgt. Powell has participated in many operational sorties. On a recent occasion his aircraft was attacked simultaneously by two Ju 88s. Despite the fact that his turret was unserviceable he operated it by hand and maintained accurate fire. His skill in directing evasive action resulted in the destruction of one of the enemy fighters and caused the other to break off the engagement.

Sgt. C. A. RENNIE, No. 214 Sqn.—Sgt. Rennie has taken part in many operational sorties as a flight engineer. On three occasions, when over German territory, his aircraft was attacked by enemy night fighters and damaged. By his coolness and efficiency Sgt. Rennie contributed much to the safe return of his aircraft.

Sgt. J. T. STANTON, No. 35 Sqn.—Sgt. Stanton, as rear gunner, has participated in many operational sorties against the enemy, and has never failed throughout to hold the confidence of his companions

Roll of Honour

Casualty Communiqué No. 198.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non operational flying casualties, fatal accidents and natural deaths.

Royal Air Force

KILLED IN ACTION.—Flt. Sgt. E. S. Bayley; Sgt. F. C. Bunclark, D.F.M.; P/O. P. Campbell; Sgt. C. H. Coakley; Sgt. A. W. Colston; Sgt. E. W. Corbett, D.F.M.; Flt. Sgt. K. Crabtree; Sgt. R. W. J. Harrison; Sgt. R. S. Horsley; Sgt. K. E. Hunt; Sgt. J. L. Jackson; Sgt. H. R. Jennings; Sgt. L. Littlewood, D.F.M.; P/O. P. Mould; F/O. R. M. Quarendon; Sgt. E. Stott.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. W. F. D. Charlton.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. H. Bottomley; Sgt. W. A. Collins; Sgt. G. W. Cox; Sgt. R. G. Giddings; Sgt. G. Jackson; P/O. R. Langley; Flt. Sgt. E. S. Mason; Sgt. E. F. Penlington; Sgt. H. F. Pocock; P/O. K. T. Reeves; Sgt. D. Towler.

WOUNDED OR INJURED IN ACTION.—Sgt. B. N. Callaghan; Sgt. A. Fraser.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. E. E. Bartholomew.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. R. W. Blades; Sgt. J. Bradley; Sgt. M. F. Carlin; Sgt. C. G. Cave; Sgt. G. G. Golding; Sgt. N. Gorfunkle; Sgt. W. M. Hurrell; Flt. Sgt. C. Mitchell; Sgt. A. Sinclair; Flt. Sgt. A. A. Smith; P/O. G. D. R. Thompson; Flt. Sgt. T. A. Vaux.

MISSING.—Sgt. W. McG. Arnott; Sgt. J. Atkinson; Sgt. G. G. M. Battison; Sgt. J. Bell; Sgt. H. W. Bending; P/O. D. J. Bradshaw; P/O. R. H. Bramwell; Sgt. S. G. Brooking; Sgt. F. A. Broom; Sgt. A. L. Bung; Sgt. G. A. Carter; Sgn. Ldr. J. N. G. Carter; W/O. D. G. Chell; Sgt. T. A. Cobb; Act. Flt. Lt. L. Cocker; Sgt. N. B. Collins; Sgt. H. Dale; P/O. W. R. N. Davidson; Sgt. R. MacF. Don; Sgt. W. R. Downing; Sgt. F. Dyson; Sgt. T. E. Edwards; Sgt. C. D. Evans; Sgt. R. G. Evison; Sgt. R. W. A. Follett; Sgt. E. C. J. Frizzell; Sgt. A. F. Goff; Sgt. M. A. Goldstein; Sgt. T. W. Grisedale; Flt. Sgt. K. G. M. Hale; P/O. G. A. Hamman; Sgt. A. E. W. Handley; Sgt. C. Hanley; Sgt. M. A. Harran; Flt. Lt. P. Heywood, D.F.C.; Act. Sqn. Ldr. P. F. Hickling; Sgt. C. S. H. Hill; Sgt. R. F. Hill; Sgt. C. C. Hockley; Sgt. F. W. Hope; Sgt. L. W. Horne; Sgt. S. F. Howe; Sgt. V. Howe; Sgt. J. E. Humphreys; Sgt. R. D. Hustler; Sgt. J. D. Jones; Sgt. T. Jones; P/O. D. St. J. Jowitt; P/O. T. J. Kingman; Sgt. F. E. Kirby; Sgt. J. H. Lovesay; Sgt. A. E. MacKrill; Sgt. I. MacLachlan; Sgt. H. MacManus; Sgt. D. F. Meade; Sgt. A. R. Morgan; Sgt. A. I. Mugford; Sgt. W. E. Raven; Sgt. G. E. Rickard; Sgt. M. V. Riddle; Sgt. A. E. Roberts; Flt. Sgt. T. Sanderson; Sgt. F. V. Smith; Sgt. G. Sparrow; Sgt. F. A. Stillman; Sgt. G. H. Stone; Sgt. J. T. Sullivan; Sgt. F. L. Tidball; Sgt. H. Y. Torr; Sgt. O. Wardle; Sgt. F. G. White; Sgt. S. Wilson (620236); Sgt. S. Wilson (1131727); Sgt. F. J. Windram; Sgt. A. V. Woolgar.

KILLED ON ACTIVE SERVICE.—Sgt. C. H. Barton; A/C.1 G. Bates; Flt. Sgt. B. H. Batten-Wilkins; A/C.1 G. Beckett; Sgt. H. M. Bruce; P/O. E. H. Canard; L.A/C. K. Collins; Sgt. A. E. Davies; P/O. J. C. Donald; Sgt. L. Evans; Flt. Lt. F. E. Everett; Sgt. D. D. Gardner; Sgt. A. F. E. Giles; Sgt. E. C. Hoffman; Sgt. J. Holderness; Sgt. G. Jones; Sgt. G. D. Lewis; Flt. Sgt. I. D. MacLean, D.F.M.; P/O. C. A. Murphy; Sgt. C. A. Phillips; Sgt. G. V. Reeves; Sgt. W. E. Rose; Cpl. S. C. Van Denbergh; Sgt. S. A. Watkins.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Sgt. G. W. Clegg; Sgt. H. S. Dunlop.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Flt. Lt. G. McL. Hayton, D.F.C.; P/O. W. J. Northcott; Sgt. D. F. Small; Act. Sqn. Ldr. H. R. K. Wells.

DIED ON ACTIVE SERVICE.—A/C.1 L. A. Ashley; L.A/C. J. Aspinall; A/C.2 A. Beckett; L.A/C. A. Bednal; L.A/C. A. J. Creed; L.A/C. K. Critchlow; A/C.2 H. F. Cross; A/C.2 T. Dickinson; Act. Sqn. Ldr. D. B. Gray, O.B.E., M.C.; Act. Sqn. Ldr. F. B. Harvey; Cpl. L. R. Hoborough; A/C.1 F. Jones; L.A/C. L. R. Jones; L.A/C. E. F. Kerslake; Cpl. W. E. Swash.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. L. D. V. Edwards; Sgt. J. G. Laurence.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—A/CW.2 G. Heath; A/CW.1 B. D. Secar.

Royal Australian Air Force

MISSING, BELIEVED KILLED IN ACTION.—Sgt. B. P. Shaddick; Sgt. T. Woodhouse.

MISSING.—Sgt. D. G. Andrews; Sgt. M. R. Hehir; Sgt. K. G. Pearce; Sgt. C. B. Sautelle.

KILLED ON ACTIVE SERVICE.—Sgt. I. F. S. McColl.

Royal Canadian Air Force

KILLED IN ACTION.—Sgt. E. M. Bowery; Sgt. T. H. Currie; Sgt. W. K. Grant; P/O. A. C. McCrady; Sgt. J. P. McGrath; Sgt. K. D. Rawson.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. J. S. Dafoe; Flt. Sgt. C. H. Finkbeiner; Act. Flt. Lt. D. S. R. Hepburn; Flt. Sgt. J. M. Jamieson; Flt. Sgt. J. W. Markie.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. W. M. Poprestone; Sgt. W. G. Roddy.

WOUNDED OR INJURED IN ACTION.—Sgt. G. J. R. Bruyere; Sgt. C. F. Harwood.

MISSING, BELIEVED KILLED IN ACTION.—P/O. W. T. Bent; Flt. Sgt. N. R. Chap; Sgt. J. Donaldson; Sgt. J. Needler; Sgt. J. L. Nibblet; Sgt. J. A. Smith, Sgt. K. B. Tanner.

MISSING.—Sgt. R. H. Baldock; Sgt. W. C. Black; Sgt. W. S. Bourke; Flt. Sgt. E. A. Boyd; Sgt. C. C. Brook; Sgt. J. P. Bulanda; Sgt. D. F. Burchell; Sgt. C. A. Davis; Sgt. N. Davis; Sgt. T. E. Dunlop; Sgt. D. C. Ferguson; Sgt. T. R. N. Fetherston; Sgt. C. B. Finley; Flt. Sgt. G. J. Foreman; Sgt. A. K. Hodkins; Flt. Sgt. K. L. Howard; P/O. D. J. MacPherson; Sgt. G. M. Manning; Sgt. P. J. Maroney; Sgt. G. A. Neville; Flt. Sgt. R. C. Payne; Sgt. J. K. Player; Sgt. W. J. Pope; Sgt. D. V. Prosser; Sgt. N. Raitblat; Sgt. G. G. Sawatzky; Flt. Sgt. W. A. Senez; Sgt. N. Siderchuck; Sgt. M. M. Stewart; Sgt. R. W. Stockton; Flt. Sgt. J. H. G. Tasse; Flt. Sgt. G. Thom; Sgt. H. V. Thompson; Sgt. W. W. Waddell; Sgt. W. R. Waddle; Sgt. A. C. Walland.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. R. G. Bell, D.F.M.; Sgt. C. S. Boomer; P/O. D. B. Clements; Sgt. W. H. O. Cole; P/O. J. L. Doray; P/O. A. A. Herbert; P/O. P. M. Matthews; Sgt. C. W. Milton; Sgt. G. W. Wilken; P/O. T. D. Withington.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. H. E. Martin; Sgt. W. J. Nicoll; Flt. Sgt. H. W. Potter.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. M. K. Nelson.

WOUNDED OR INJURED IN ACTION.—Sgt. H. R. Johnston; Sgt. R. J. Wright.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. I. Kennedy; P/O. J. A. Logan.

MISSING.—Sgt. A. F. Badcock; Sgt. G. W. Everett; Sgt. J. W. Fenton; Sgt. I. I. Friend; Sgt. K. F. Gardiner; Sgt. H. A. Harris; Sgt. W. W. Morgan; Sgt. A. H. Thomson.

South African Air Force

KILLED IN ACTION.—Lt. B. Nichols.

WOUNDED OR INJURED IN ACTION.—Lt. L. C. H. Hoce.

KILLED ON ACTIVE SERVICE.—Lt. S. J. Becker.

SERVICE AVIATION

Casualty Communiqué No. 199.

Royal Air Force

KILLED IN ACTION.—Sgt. R. R. Abercrombie; F/O. W. F. Amos; Sgt. P. P. Armstrong; Sgt. F. O. Button; Sgt. R. E. Cordrey; Flt. Sgt. O. G. Davies; Flt. Sgt. M. G. Everard; Sgt. L. Greenwood; Sgt. O. L. Holmes; Sgt. A. B. Jackson; Sgt. R. A. King; Sgt. C. S. McCormick; P/O. S. C. Morrison; Sgt. H. Williamson; Sgt. R. G. Workman; Sgt. J. E. Young.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. D. J. East; Sgt. J. Garroway; Sgt. W. H. Orman.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. H. Cartwright; Sgt. R. D. Cullingham; Sgt. I. Edwards; Act. F/O. E. C. L. Hebblethwaite; Flt. Sgt. E. W. Jackson; Sgt. F. R. Mills; P/O. A. S. Morley; Sgt. T. K. Robinson; Sgt. F. W. Slingo; Sgt. E. C. Smith; Act. Sqn. Ldr. A. J. D. Snow.

WOUNDED OR INJURED IN ACTION.—P/O. C. P. Cutting, D.F.M.; Flt. Sgt. J. Medani.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. R. R. Best.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. S. Broome; Flt. Sgt. T. G. Lishman; Sgt. W. A. Moir; Sgt. O. V. Owen; Sgt. M. H. Peacock; Sgt. P. Richardson.

MISSING.—Flt. Lt. L. A. Bale; Sgt. E. Bates; Sgt. R. M. Bland; Flt. Sgt. N. Booth; Sgt. J. G. Cairns; P/O. K. Charman; Sgt. A. H. Clayton; Sgt. V. H. Cusden; Sgt. J. G. Duncan; Flt. Sgt. R. Easom; Sgt. A. G. Elliot; Sgt. F. Ferguson; Sgt. L. H. Fox; Sgt. A. C. Girdlestone; Act. Sqn. Ldr. J. R. Goldston; Sgt. R. Gregg; Sgt. R. I. Gruber; P/O. F. C. Hammond; Sgt. B. P. Horwood; Flt. Sgt. M. C. Humphrey; Sgt. E. Hyland; Sgt. A. G. Langton; Sgt. J. C. Leach; Sgt. V. J. Lee; Sgt. F. R. Lewsley; Sgt. C. Mc Creedy; Sgt. H. L. J. Mackender Sgt. R. Millar; Sgt. W. W. Moss; Sgt. J. Obbard; Sgt. J. J. Perry; Sgt. W. G. Plummer; Sgt. O. R. Shepperson; Sgt. W. Skinnor; Sgt. R. H. Soutter; Flt. Sgt. R. Spencer; Sgt. J. F. H. Steer; Sgt. G. Tough; Sgt. F. A. Turner; Sgt. E. H. Uzzell; Sgt. R. Webb; Sgt. S. A. Whear; Sqn. Ldr. F. C. Willis.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—L.A/C. S. Kyle; Flt. Sgt. J. B. MacDermott.

KILLED ON ACTIVE SERVICE.—Sgt. F. W. J. Allfrey; Sgt. B. Bamford; L.A/C. A. J. Baxter; Sgt. A. E. Beach; Wing Cdr. H. St. G. Burke; Sgt. N. J. H. Carter; Sgt. S. H. Clarke; Flt. Sgt. J. A. Clough; Sgt. C. L. Coleman; L.A/C. G. W. Cornish; Flt. Sgt. W. S. Crowe; Sgt. C. W. H. Davie; Sgt. L. A. Egbers; Sgt. G. L. Ellsworth; Sgt. O. S. Endersby; F/O. S. A. Fannon; Sgt. L. V. Fossieltner; Sgt. D. T. Gale; Flt. Sgt. J. Haddow; P/O. G. V. J. Hawkes; Act. Flt. Lt. E. L. Hetherington, D.F.C.; Sgt. C. Hill; Sgt. D. A. J. Holloway; Sgt. F. Hughes; Act. Sqn. Ldr. W. C. Hutchings, D.F.C.; P/O. R. W. James; Sgt. W. A. Jolly; Sgt. A. W. Jones; L.A/C. T. S. Jones; Act. F/O. A. Kerr; Wing Cdr. W. St. J. Littlewood, O.B.E.; F/O. R. K. Luddington; Sgt. J. A. McArdle; Act. Sqn. Ldr. G. R. MacDonald; Sgt. J. T. McKay; Sgt. J. Mallet; P/O. J. W. Marshall; P/O. T. Mason; P/O. F. Mayes; Sgt. R. E. Newson; L.A/C. C. H. Nield; Sgt. G. J. Owens; Sgt. R. O. Parker; P/O. O. Pedersen, Sgt. C. G. Plimmer; Flt. Sgt. N. Saravanos; P/O. J. B. Seigne; L.A/C. R. A. Simpson; Sgt. D. W. J. Spencer; L.A/C. D. C. Stacey; Sgt. A. J. Stone; Sgt. A. E. Trott; Grp. Capt. H. M. Whittle; Flt. Sgt. K. Williams; Sqn. Ldr. J. P. Winfield; P/O. S. D. Warner.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. B. J. D. Warde.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. J. Bennett; Sgt. K. J. Johnson.

WOUNDED OR INJURED ON ACTIVE SERVICE.—P/O. J. P. Bassett; P/O. G. F. Beurling, D.S.O., D.F.C., D.F.M.; Sgt. H. T. Forrest; P/O. R. C. T. Goodwin; L.A/C. A. Green.

DIED ON ACTIVE SERVICE.—A/C.1 G. Anderson; Sqn. Ldr. H. J. S. Anderson; Sgt. A. A. Blake; A/C.2 T. Coonan; F/O. F. Eagling; A/C.1 F. E. Flower; Act. Sgt. A. W. Greenwood; L.A/C. S. D. Hembrow; L.A/C. J. Holden; Sgt. J. Lewis; L.A/C. C. R. J. Phelps; L.A/C. G. Reynolds; Sgt. W. O. E. Saunders; A/C.1 J. W. Sidell; Cpl. K. Silvester; A/C.1 D. N. Tesare; L.A/C. S. Tennet, A/C.1 F. W. Thornton; A/C.1 J. C. Todd; A/C.1 P. D. Trinder; A/C.2 G. Turton; Sgt. W. J. Vick.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—A/C.W.2 A. J. Davies.

Royal Australian Air Force

KILLED IN ACTION.—Sgt. L. H. Austin; F/O. J. D. Hay; Sgt. A. S. B. Paterson; Sgt. G. P. Turner; Sgt. W. H. Warren.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. T. F. McGregor-King; P/O. W. B. Shearer.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. C. A. V. Hartley; Sgt. G. H. G. Murray.

SERVICE AVIATION

WOUNDED OR INJURED IN ACTION.—Sgt. D. W. P. Borthwick; F/O. F. J. Lees; Sgt. W. J. Nicholas; Sgt. D. C. Oliphant; Sgt. S. J. Smith.

MISSING, BELIEVED KILLED IN ACTION.—P/O. C. A. Graham; F/O. A. M. Howe.

MISSING.—L.A/C. I. W. Batton; Flt. Sgt. R. R. Silfcock.

KILLED ON ACTIVE SERVICE.—P/O. T. J. Donohue; Sgt. J. D. Pickup; Sgt. N. W. Reid.

Royal Canadian Air Force

KILLED IN ACTION.—Sgt. R. N. V. Burke; Sgt. R. R. Foltz; F/O. C. L. Horncastle.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. G. H. Steinhauer.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. J. R. Laporte.

MISSING, BELIEVED KILLED IN ACTION.—F/O. R. F. L. Anderson; Sgt. M. K. Callan; Sgt. E. H. Kingsland; Sgt. D. T. Merler; Sgt. F. W. Read; Sgt. J. H. Zealand.

MISSING.—Sgt. W. S. Beale; P/O. R. S. Braley; Sgt. C. Collard; F/O. G. G. Davidson; Sgt. F. K. J. Dunajski; Flt. Sgt. J. H. Ekelund; Sgt. H. A. Elliott; Sgt. B. Fisher; Flt. Sgt. W. N. Guertin; Sgt. F. J. Hogan; F/O. F. C. M. Jemmett; P/O. J. D. Lindsay; Sgt. H. F. Locke; Sgt. J. D. McDonald; Sgt. E. Macnall; Sgt. F. L. Olsen; P/O. C. R. Scollan; Sgt. A. J. M. Smith; Sgt. C. S. Snider; Sgt. J. M. Stephen; Flt. Sgt. K. E. Stilborn.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. R. H. Davey; Sgt. M. Funk; Sgt. J. R. Gould; Sgt. J. A. Larche; Sgt. K. P. Mercer; Flt. Sgt. C. E. Mutch; Sgt. A. E. Shelson; Sgt. W. Sokol; Sgt. J. W. Spinney.

Royal New Zealand Air Force

KILLED IN ACTION.—Sgt. J. H. Barry; Sgt. L. L. A. Craig; Sgt. K. L. Donald; Sgt. H. H. Earney.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. D. G. Box.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—P/O. H. J. G. Haeusler.

MISSING.—Sgt. T. M. Blakemore; P/O. M. S. Gilberd; Flt. Sgt. E. H. Howell; Sgt. W. H. Lipquey; Sgt. A. Martin; Sgt. P. G. Nelson; Sgt. M. A. Torrance.

KILLED ON ACTIVE SERVICE.—Sgt. H. W. A. Collett; Sgt. F. Kinnon; P/O. W. Lee.

WOUNDED OR INJURED ON ACTIVE SERVICE.—P/O. S. C. Taylor.

South African Air Force

KILLED IN ACTION.—Lt. W. J. S. A. Webb, D.F.C.

MISSING.—Lt. G. W. Brodziak; Lt. V. R. Burden; Major A. M. Colenbrander; Lt. H. S. McMaster.

KILLED ON ACTIVE SERVICE.—2/Lt. G. G. Davidson.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—2/Lt. W. B. Wolfe.

Indian Air Force

DIED ON ACTIVE SERVICE.—Act. Flt. Lt. B. K. Nanda.

Casualty Communique No. 200.

Royal Air Force

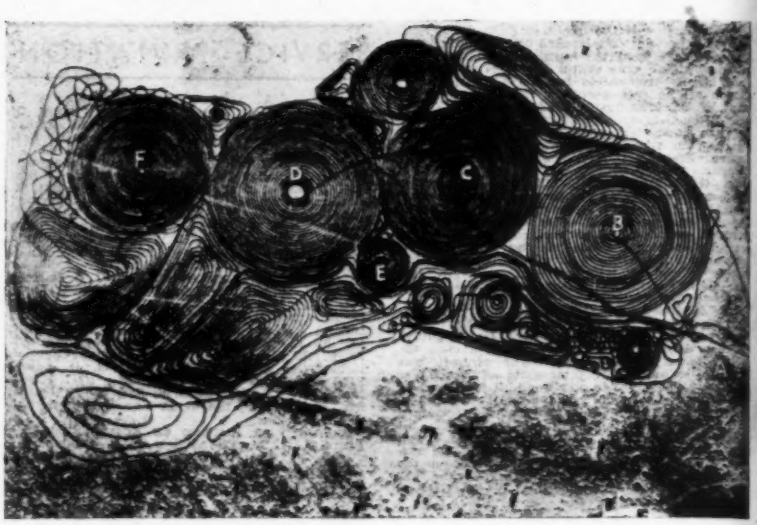
KILLED IN ACTION.—Sgt. J. H. Baillie; Sgt. W. Collins; P/O. R. P. Gent; P/O. J. S. Greig; P/O. T. Howell; Sgt. W. Owen; Sgt. I. L. Parsons; Flt. Sgt. E. E. Robbins.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. J. H. Alexander; Sgt. E. Annable; Sgt. G. F. C. Bonner; Sgt. H. R. Camfield; Sgt. J. J. Clifton; Sgt. R. R. Parry; Sgt. H. H. Stott.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. R. G. Addis; Sgt. W. D. Amos; Sgt. R. Batman; Sgt. D. W. Bond; P/O. L. E. Bradbury; Sgt. H. Cliffe; Sgt. A. R. Clouston; Flt. Sgt. D. G. S. Corden; Grp. Capt. H. W. Corner, A.F.C.; Sgt. G. W. Craft; Sgt. T. A. F. Davies; Sgt. S. Davis; Flt. Sgt. C. Dawson, D.F.M.; Act. Flt. Lt. D. P. Drussell; Sgt. O. R. East; Sgt. L. F. Evans; P/O. J. Fisher; L.A/C. W. A. Fisher; F/O. J. Flynn; Sgt. C. G. Freeman; Sgt. A. J. Fromings; F/O. P. G. C. Gimson; Flt. Sgt. F. J. Golightly; P/O. T. G. Grantham; Sgt. P. F. Green; Sgt. A. Hague; Sgt. E. A. Hall; Sgt. W. Hall; P/O. F. S. Haslett; P/O. R. L. Hayes; Sgt. J. V. Hill; Sgt. E. G. Kendall; P/O. S. R. Leney; P/O. J. Marr; Sgt. D. C. Martin; F/O. A. Palmer-Tomkinson; Sgt. A. Penman; P/O. R. A. Petherbridge; Flt. Sgt. C. P. Philp; Sgt. J. W. Porteous; Sgt. P. Roy; Sgt. T. J. Savage; Sgt. L. D. Sollars; Act. Flt. Lt. A. C. Stevens-Fox; P/O. H. A. Sullivan; Flt. Sgt. D. W. Taylor; Sgt. W. Walton; Sgt. C. J. N. Watkin; Act. Flt. Lt. V. E. Watkins; Act. Flt. Sgt. H. S. Wheatley; F/O. R. Wheldon Sgt. B. E. Whitbread; P/O. G. W. Wilkinson; Flt. Sgt. A. C. R. Wilson.

WOUNDED OR INJURED IN ACTION.—P/O. F. A. Howard.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. J. De La W. Anstruther; Flt. Sgt. J. R. Brown; P/O. E. G. Clegg; Sgt. R. B. Greensmith; Sgt. G. Grove; P/O. C. W. Kaye; P/O. R. C. J. McClumpha; Flt. Sgt. J. C. McCombie;; P/O. A. R. H. Maynard; Sgt. C. J. Murray; Sqn. Ldr. P. De G. H. Seymour; F/O. J. C. D. Squibb; Sgt. J. Walder; Flt. Sgt. W. L. Williams.



PROBLEM PICTURE : An airfield in Tripolitania ploughed by the *Luftwaffe* before retreating. The official intelligence report on the photograph reads : The complicated clock movement is the result of ploughing up the area. That it is so dark is due to the very red soil. Three tractors were employed. All started from A. Tractor 1 went to B and started ploughing from the centre outwards. He was a bit "jerky" on his driving. Tractors 2 and 3 proceeded to D, where tractor 2 started ploughing from the centre outwards. He ploughed very closely. Tractor 3 went on from C to D, where he started ploughing from the centre outwards, and made a very neat job of it. Their subsequent movements are of some interest. For instance, tractor 2 made the little circle at E after finishing C. He then went on and did circle F. Tractor 3, after circle D, made circle G. At this point they either packed up for lunch or for the day. At any rate they subsequently came back, but now having awkward shapes to fill in they started at the outside and worked inwards. Hence the untidiness of some of the other parts.

MISSING.—Sgt. R. D. Allen; P/O. A. Booth; Sgt. H. Carter; Sgt. T. Connor; Sgt. B. H. C. Conway; P/O. I. G. E. Davidson; Sqn. Ldr. G. A. Edney; Sgt. W. R. St. G. Fairfield; Sgt. P. J. Flynn; Wing Cdr. H. D. Fraser, O.B.E.; Sgt. C. E. Gray; Sgt. W. G. Greaves; W/O. G. R. E. Gregory; P/O. R. S. Griffin; Flt. Sgt. H. Haddow; P/O. C. R. Hall; Sgt. C. Heskel; Sgt. B. C. D. Holmes; Sgt. C. Hotchkiss; Sgt. G. Johnson; Sgt. J. M. Jones; Sgt. K. A. S. Keston; Sgt. J. W. Layton; Sgt. W. Leadbetter; Sgt. G. Love; P/O. J. J. Lynn; Act. Flt. Lt. G. L. Maxton; Flt. Lt. J. H. D. Mercer; P/O. L. L. Mink; Sgt. S. C. Mintern; Sgt. E. Mudd; Sgt. T. R. Parker; Sgt. W. H. Parsons; P/O. R. B. Pearson; Sgt. J. E. Roberts; P/O. R. R. Sargent; Sgt. R. G. Smith; Sgt. R. E. Swift; Flt. Lt. R. Tudor-Jones; Sgt. H. V. Watson; Sgt. T. A. West; Sgt. J. D. L. Williams.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—F/O. C. A. Blackburn; F/O. F. C. Hill.

KILLED ON ACTIVE SERVICE.—Wing Cdr. H. R. Allen; P/O. A. H. Baker; L.A/C. J. D. Barnes; Flt. Sgt. H. Beswick; Sgt. H. W. S. Bristow; Sgt. I. Bygrave; Sgt. R. H. Church; Sgt. A. E. Clay; Sgt. F. S. Fisher; P/O. J. A. Gilbert; Sgt. T. W. Haver; P/O. W. J. Havies; Sgt. F. E. Hewitt; Sgt. B. Hillberg; P/O. S. C. Izod; L.A/C. A. C. Lever; Sgt. G. Lunn; Sgt. G. Maguire; P/O. J. K. Matthews; Sgt. F. P. Nettleton; F/O. G. Pepper, D.F.C.; Sgt. R. L. Pett; Sgt. R. Stone; Act. Sqn. Ldr. J. M. Strawson, D.F.C.; Sgt. J. M. Sutcliffe; P/O. H. E. Talbot; P/O. W. R. Taylor; P/O. J. H. Toone; Sgt. F. H. G. Trimmer; Cpl. E. W. Tull; Sgt. R. J. Walker; Sgt. B. H. Walter; Sgt. A. Walton; L.A/C. W. J. White; P/O. E. G. S. Wilson-Steele.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. S. C. G. Blowes; P/O. F. W. Walker, D.F.C.

WOUNDED OR INJURED ON ACTIVE SERVICE.—A/C.2 F. Beswick; Sgt. A. J. Cooper; P/O. O. C. Mundin; P/O. D. S. Williams.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—A/C.1 R. L. Brooks; Sgt. K. V. G. Collings.

DIED ON ACTIVE SERVICE.—L.A/C. R. W. T. Alford; L.A/C. F. Bullock; Sgt. S. W. Fellows; A/C.1 D. R. H. Guest; L.A/C. T. E. Harrison; Act. Sqn. Ldr. C. M. Horsfall; L.A/C. O. S. Howlett; L.A/C. J. Ives; L.A/C. J. C. Marott; P/O. E. A. P. Martin; L.A/C. T. Moore; Act. Sqn. Ldr. T. E. S. Norris; L.A/C. R. S. Seddon; A/C.1 A. T. Sives; W/O. R. Thompson; A/C.2 J. Turner; A/C.2 F. L. Winter.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—L.A/CW. P. Taylor.

Royal Australian Air Force

KILLED IN ACTION.—P/O. R. B. Park; Sgt. L. J. Sommerville.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. R. W. Brindley; P/O. B. J. Halse; Sgt. L. P. Mooney; P/O. D. J. Richards.

MISSING, BELIEVED KILLED IN ACTION.—F/O. J. W. Upward.

MISSING.—P/O. F. Alderson; Sgt. R. L. D. Phair; Sgt. W. G. Sharpe; Sgt. J. L. M. Thomson; Sgt. A. J. Tippett.

KILLED ON ACTIVE SERVICE.—P/O. R. H. Chapman; Sgt. M. W. Marshall; Act. Sqn. Ldr. B. M. Terry; F/O. A. H. Wood.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. T. Essam.

Royal Canadian Air Force

KILLED IN ACTION.—P/O. G. S. Cartwright; Sgt. H. M. Lisson; P/O. J. F. Sweet; Sqn. Ldr. L. H. Wilkinson.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. R. B. Petersen.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Act. Flt. Lt. E. D. Baker; Flt. Sgt. D. L. Ballingall; P/O. N. F. Bowsher; Flt. Sgt. S. S. Dawes; Flt. Sgt. L. W. Fletcher; P/O. J. D. A. Foley; Sgt. A. K. Hamilton; Sgt. J. F. P. H. Lafreniere; Sgt. N. A. Leckie; P/O. R. P. Locke; P/O. H. M. Lowry; W/O. D. A. McCann; Sgt. G. N. Moore; Sgt. W. J. Smart; P/O. H. R. Strouts; Flt. Sgt. G. J. Wilkie.

WOUNDED OR INJURED IN ACTION.—Sgt. R. De Bourke.

MISSING.—Flt. Sgt. C. T. Allen; Sgt. J. Fearside; Sgt. K. S. Gunning; P/O. G. H. Kelly; Sgt. H. M. Lane; Sgt. C. R. McMullin; Sgt. T. H. Short; F/O. D. M. Witherspoon.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—F/O. H. D. Milne.

KILLED ON ACTIVE SERVICE.—F/O. T. R. Brownfield; Sgt. J. N. Cabelder; F/O. R. M. Curphey; P/O. D. A. Dawson; Cpl. J. H. C. Emburry.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Flt. Sgt. T. T. Young.

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KILLED IN ACTION.—Flt. Sgt. E. M. Corlett.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. S. W. Reid; Sgt. J. N. Vincent.

MISSING.—P/O. C. W. Clare; F/O. I. J. Fairbairn; Sgt. W. E. Hammond; Sgt. D. L. G. Millar; P/O. M. J. Mills; Sgt. H. Roberts; Sgt. R. R. T. Sleep.

KILLED ON ACTIVE SERVICE.—F/O. F. S. Haden; P/O. M. C. Jolly

South African Air Force

MISSING.—Lt. A. J. Lawrens.